Joint C4ISR Outcome-Based Integrated Architecture Assessment (JCOBIAA)

Joint Feasibility Study Report

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JCOBIAA
(Joint C4ISR Outcome-Based Integrated Architecture Assessment)

JOINT FEASIBILITY STUDY REPORT

Executive Summary

Introduction

The Joint C4ISR Outcome-Based Architecture Assessment (JCOBIAA) Joint Test & Evaluation (JT&E) proposes to test, evaluate, and enhance a methodology to assess C4ISR architectures. The methodology consists of a set of analytical tools and end-to-end testing to identify and eliminate deficiencies in a Joint C4ISR architecture. The Joint Test focuses on the Joint Task Force (JTF) Commander's need to rapidly assess an Integrated Joint C4ISR Architecture prior to deployment. Such an assessment methodology ensures C4ISR systems interoperability before forces arrive in theater, thereby enhancing a Commander's ability to conduct rapid decisive operations. The approach is to conduct a broad risk analysis across the total C4ISR architecture to identify interoperability issues among those organizational elements and systems that have a high-risk of jeopardizing the mission outcome. Those high-risk areas are further investigated using higher resolution tools to pinpoint specific deficiencies and suggest solutions. End-to-end testing will also be conducted to verify deficiencies and solutions. The methodology will be validated in the JT&E through a risk mitigation demonstration of data availability, participation in Service Battle Laboratory C4ISR experiments, participation in at least two large-scale JTF training exercises, and participation in an operational exercise. Although the JT&E is focused at the JTF level, the methodology applies to the Commanders'-in-Chief (CINC's) theater architectures, Component Command's architecture, Service architectures, and to coalition force's architectures.

Problem Statement/Issues

The problem statement for the JCOBIAA JT&E was developed and refined through meetings with the JCOBIAA Operational Advisory Group (OAG), the JCOBIAA Senior Steering Group, and Warfighting CINCs.

The problem statement is:

The Joint Task Force (JTF) Commander has insufficient means to identify deficiencies and solutions within the C4ISR architecture.

This problem statement leads to four issues:

- **Issue 1.0:** How timely, accurately, and completely does the methodology populate its analytical tools with JTF information?
- **Issue 2.0:** How timely, accurately, and completely does the methodology identify deficiencies in the JTF C4ISR architecture?
- **Issue 3.0:** How timely, accurately, and completely does the methodology identify solutions to deficiencies in the JTF C4ISR architecture?
- **Issue 4.0:** How suitable is the methodology for use by the Warfighter.

Is a JCOBIAA JT&E needed?

The primary purpose of the Joint Feasibility Study (JFS) is to determine the necessity and feasibility of conducting the JT&E. The Feasibility Study Director (FSD) and study team members have researched relevant Joint publications, exercise reports, lessons learned from real world operations from Desert Storm to Bosnia and Kosovo, Commander-in Chief Integrated Priority Lists (IPLs), and the Joint C4ISR Battle Laboratory (JBC) CINC Requirements Office (CRO) surveys. In addition the FSD has visited and briefed Flag Officers and General Officers (FOGOs) of all Services, senior OSD personnel, and Joint Staff members. The FSD also briefed at Joint C4ISR architecture conferences, interoperability seminars, and architecture development courses of instruction. All visited and briefed sources have agreed to the necessity of conducting a JCOBIAA JT&E that offers the potential to greatly increase C4ISR readiness for a JTF Commander prior to deployment.

In addition to numerous letters of endorsement from senior leadership within the services, the following quotes from three Commanders-in-Chief at Senate Armed Services Committee testimony on 27 March 2001, further illustrate the necessity of effective C4ISR architectures:

"Today, severe deficiencies in command, control, communications, computers, and intelligence (C4I) functionality impair our ability to execute the war plan. Information Superiority that President Bush describes is best achieved by building a C4I architecture that embraces the principles of network-centric warfare….."

GEN Thomas Schwartz (USA)
Commander-in-Chief United Nations
Command/Combined Forces Command/
Commander, U.S. Forces Korea

C4 is my "top resource priority."

ADM Dennis Blair (USN),
Commander-in-Chief
U.S. Pacific Command

"The command is enhancing its C4I architecture for fixed and mobile operations throughout the region …vitally important to our deployed forces."

Gen. Peter Pace (USMC)
Commander-in-Chief
U.S. Southern Command

Currently there is no rapid, "all-encompassing" method to assess C4ISR architectures to determine their effectiveness for the mission. The JCOBIAA JT&E will provide a test validated C4ISR architecture assessment capability as an end product.

U.S. Joint Forces Command, (USJFCOM) endorses this proposal and has provided the Study Director's billet, and suitable office spaces to house the study team. During the test JFCOM will also provide access to test facilities and JTF training venues. The Navy as the lead Service, will pay lease costs to house the test team

Is a JCOBIAA JT&E feasible?

The feasibility of conducting a JCOBIAA JT&E has been addressed through a series of Proof-of-Concept demonstrations of the methodology. At the highest level of analysis, a risk assessment tool that has been successfully employed by the Navy to address large-scale, complex C4ISR interoperability issues has been adopted by JCOBIAA to address joint interoperability issues. This risk assessment tool was successfully populated with the necessary data and predicted high-risk areas in the C4ISR architecture that could be critical to mission success. One of these high-risk areas was further investigated using a higher resolution dynamic analysis tool. This tool was also populated with its required data and executed to predict the mean time for an equipment string to pass a critical message. The end-to-end testing aspect of the methodology was also demonstrated via a thorough investigation and observation examination of the capabilities of the Joint C4ISR Battle Laboratory's (JBC) Joint C4ISR Integration Facility (JCIF) to replicate the necessary JTF C4ISR system architectures for testing. Consultation with members of the Federated Battle Laboratories (FBL) of which JBC is the chair, indicated that a suitable distributed end-to-end testing environment will be available as part of the validation process. Test venues have been investigated and selected that cover a broad spectrum of the levels of warfare. Test schedules have been developed and matured that will allow a smooth transition to the development of a Program Test Plan (PTP) and a Data Management and Analysis Plan (DMAP) in order to validate the methodology in the follow-on JT&E. The Navy as lead service, and USJFCOM as Executive Agent, agreed to provide the necessary resources to conduct a successful JT&E. The May 2001 Technical Advisory Board judged JCOBIAA to be feasible and executable.

Recommendations

Today's military operations across all levels of warfare are conducted in a complex environment of technologically sophisticated C4ISR equipment, multi-service participation, and coalition forces. Warfighting strategies are increasingly dependent on collaboration and reach-back capabilities, which require C4ISR interoperability. This complexity and diversity is managed through C4ISR architectures that provide the foundation to maintain Information and Decision Superiority. A methodology to assess and enhance those architectures prior to deployment of forces greatly increases the probability of a favorable military outcome. Testing facilities for individual C4ISR systems exist but none examine the total JTF C4ISR Integrated Architecture.

Summary

The JFS has concluded that there is a need and it is feasible to test and evaluate a methodology to improve the assessment of a Joint Task Force (JTF) C4ISR architecture. The proposed JT&E is endorsed by the warfighter as necessary. Proof-of-concept demonstrations indicate that the proposed test is technically feasible and that the resources are available to conduct a successful test. Products from the test will periodically be made available to the warfighter as the test progresses, ensuring rapid payoff to the users. The successful chartering of JCOBIAA in August 2001 now initiates the implementation of the formal test planning and execution phases.

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1.0 INTRODUCTION

1.1 BACKGROUND

Congress established the Joint Test and Evaluation (JT&E) Program in 1972 after a Presidential Commission concluded that the Department of Defense (DoD) had no capability to conduct test and evaluation in a joint environment. The Commission recommended the responsibility for joint testing be vested in the Office of the Secretary of Defense (OSD), which now exercises program leadership and publishes guidance in the form of DoD Directive 5010.41, handbooks, policy letters, and memoranda of agreement.

OSD sponsors the JT&E Program to conduct tests and evaluations and provide information required by Congress, OSD, the Unified Commands, Services, and DoD components relative to joint operations. The JT&E Program is directed by the Director, Strategic and Tactical Systems (D,S&TS), Office of the Undersecretary of Defense (Acquisition, Technology, and Logistics). The responsibility for management of the program is vested in the Deputy Director, Developmental Test and Evaluation (DD,DT&E) and executed by the JT&E Program Manager.

The Joint C4ISR Outcome-based Integrated Architecture Assessment (JCOBIAA) is co-sponsored by the Navy as lead Service, and by U.S. Joint Forces Command (USJFCOM) as executive agent. This report provides the results of the Joint Feasibility Study (JFS).

1.2 PURPOSE

1.2.1 Joint Feasibility Study Purpose

The primary purpose of the JFS is to assess the necessity and feasibility of conducting a JT&E to address Joint C4ISR architectures problems and related issues. In answering the necessity question, this JFS explores the support and need for the test with the Services, JCS, CINCs, and Department of Defense Field Activities. This culminates in the identification of legacy customers for use of products identified in the proposed test. During the study, a Technical Advisory Board (TAB) receives several briefings from the Joint Feasibility Study Director (FSD) designed to demonstrate technical feasibility. The TAB is composed of senior test and evaluation scientists from OSD, the Services, and DoD Agencies.

The TAB briefings review the study's ability to address the following:

- Development of a concise problem statement
- Identification of test issues, sub-issues, measures, and data requirements
- Scope of the test
- Development of the test concept and scenarios
- Development of an executable test methodology to include: data collection, data management, and instrumentation
- Development of an analysis and evaluation methodology
- Investigation of test venues
- Determination of resources required

1.2.2 JCOBIAA Purpose

The purpose of the JCOBIAA Joint Test & Evaluation (JT&E) is to test, evaluate and enhance a methodology to assess Joint C4ISR architectures to ensure systems interoperability. The methodology consists of a set of analytical tools and end-to-end testing to assess the C4ISR architecture. The Joint Test focuses on the Joint Task Force (JTF) Commander's need to rapidly assess an Integrated C4ISR Architecture in order to enhance C4ISR readiness prior to deployment. Although focused at the JTF level, the methodology applies to the CINCs, Component Commands, and to coalition forces.

The future view of U.S. military operations is outlined in the Chairman of the Joint Chiefs of Staff (CJCS) document, Joint Vision 2020 which is a conceptual framework to achieve new levels of effectiveness in joint warfighting. The basis for this framework is found in improved command, control, and intelligence that transform traditional military functions into new operational concepts. C4ISR architectures that ensure information superiority will enable full spectrum dominance to be achieved over the full range of military operations.

Information Superiority is getting the right information to the right person at the right time in the right form to improve the decision making process. The underlying assumption is that a more informed decision-maker will make better decisions leading to Decision Superiority. Those decisions and their subsequent outcomes are directly affected by the effectiveness of a C4ISR Integrated Architecture. The essence of this JT&E is to establish and validate a methodology to rapidly assess JTF integrated architectures for the purpose of improving Joint C4ISR interoperability prior to deployment.

1.3 AUTHORITY

On 13 July 2000, the D,S&TS based on the recommendation of the JT&E Senior Advisory Council (SAC) to conduct a Joint Feasibility Study (JFS) approved JCOBIAA.

In accordance with JT&E guidelines, Department of Defense (DoD) Directive 5010.41, the Joint Test and Evaluation (JT&E) Program, U.S. Joint Forces Command as Executive Agent and the Navy as Lead Service are committed to support JCOBIAA with the necessary facilities to conduct a successful JT&E.

The following referenced letters document the commitment of USJFCOM and the U.S. Navy to support JCOBIAA.

- U. S. Joint Forces Command Letter dated 17 March 1999, Serial 8U0016
- Space and Naval Warfare Systems Command Letter dated 19 Nov. 1998, Serial 00/48
- U. S. Joint Forces Command Letter dated 5 May 2000, Serial 0U0018

1.4 "IS NEEDED" RESOLUTION

The primary purpose of the JFS is to determine the necessity and feasibility of conducting the JT&E. To assist in this process, the FSD and study team members have researched relevant Joint publications, exercise reports, lessons learned from real world operations (from Desert Storm to Bosnia and Kosovo), Commander-in Chief Integrated Priority Lists (IPLs) and the results of a survey of C4ISR requirements by the Joint C4ISR Battle Laboratory (JBC) CINCs' Requirements Office (CRO). In addition, the FSD has visited and briefed Flag Officers and General Officers (FOGOs) of all Services, Joint Staff members, C4ISR conferences, Interoperability seminars, and senior OSD personnel. All have agreed to the necessity of conducting a JCOBIAA JT&E that offers the potential to greatly increase combat power through more efficient use of C4ISR.

From an historical perspective, the problems associated with inadequate Joint C4ISR in military operations span a long history (Lifting the Fog of War, William A. Owens, Ed Offley/Farrar, Straus & Giroux, Incorporated/April 2000.) Examples from ADM Owens (USN Ret.) range from lack of inefficient inter-service communication at Pearl Harbor through friendly-fire casualties during Desert Storm. Serious and systematic flaws in the planning, organization, and operational design of the raid at Desert One Site in Iran were never detected resulting in loss of life and a failed mission. Poor coordination between service flying units over the no-fly zones in Northern Iraq resulted in loss of American lives through fratricide. Having reviewed several reports on fratricide, Owens concluded that "the connecting link in the vast majority of the incidents involved misperceptions and human error caused by the lack of proper data links, the lack of common operating procedures among the different services, and -overall- the residual impact of individual service cultures that precluded a truly "joint" situational awareness." These are all examples of a breakdown in some aspect of a Joint C4ISR architecture.

More recent examples of the problems associated with inadequate C4ISR architectures were also found in lessons learned from Kosovo (OSD White Paper, "Kosovo DoD Studies" Oct 1999) and Bosnia (Bosnia Lessons Learned, C4ISR Cooperative Research Program (CCRP), National Defense University; sponsored by ASD(C3I), 1997). A synopsis of these C4ISR lessons learned include:

Kosovo

- The integration of existing ISR platforms, is as important as acquiring new sensors.
- New processes and innovative initiatives discovered in operations are important to document and institutionalize.
- Create a joint process for rapidly surging C2ISR to support emerging crisis and combat operations.
- OPSEC/COMSEC and other serious vulnerabilities observed.
- Better information management processes are needed and possible.

Bosnia

- Effective C4ISR is a critical ingredient for military success.
- Integrated C4ISR was desired but stove-pipes were a reality.
- Constant uncertain planning and operational environment hindered operations.
- US approach to C4ISR architecture uncertainty was to "flood" the theater with resources - NATO wanted efficiency.
- Significant OJT training programs were required to train staffs.

The following quotes from three CINCs at Senate Armed Services Committee testimony on 27 March 2001 further illustrate the necessity of conducting a JCOBIAA JT&E today:

> **"Today, severe deficiencies in command, control, communications, computers, and intelligence (C4I) functionality impair our ability to execute the war plan. Information Superiority that President Bush describes is best achieved by building a C4I architecture that embraces the principles of network-centric warfare…"**

GEN Thomas Schwartz (USA)
Commander-in-Chief United Nations
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> **C4 is my "top resource priority."**

ADM Dennis Blair (USN),
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U.S. Pacific Command

> **"The command is enhancing its C4I architecture for fixed and mobile operations throughout the region … vitally important to our deployed forces."**

Gen. Peter Pace (USMC)
Commander-in-Chief
U.S. Southern Command

This JT&E proposal is endorsed by U.S. Joint Forces Command, as Executive Agent who will provide: access to test facilities e.g. the Joint C4ISR Integration Facility (JCIF) and access to JFCOM's JTF training venues for all CINCs. As lead Service, the Navy is providing facilities costs, military personnel, government personnel, and access to System Engineering test facilities at SPAWAR Systems Center, Charleston, SC. The Navy has also committed funds to implement JCOBIAA generated joint requirements into the Joint Tool for Interoperability Risk Assessment (JTIRA) to ensure early delivery of a suitable joint legacy product.

2.0 PROPOSED JOINT TEST DESCRIPTION

2.1 INTRODUCTION

The JCOBIAA JT&E proposes to test, evaluate, and enhance a methodology to assess Joint C4ISR architectures. The JT&E will be comprised of five sequenced events: a risk reduction event to mitigate risk associated with possible deficiencies in required data; a laboratory Mini-Test; two test events comprising of JTF-level exercises with laboratory support; and a Joint Communications Support Element (JCSE)-supported operational event. Joint C4ISR architecture deficiencies observed in these test events will be compared with deficiencies predicted from the JCOBIAA methodology in order to validate the methodology. Solutions suggested from the analytical process will be tested in a laboratory environment to further validate the methodology.

In this portion of the report, it is important to understand the distinction between the JCOBIAA methodology and the JT&E itself.

The methodology is comprised of:

- The use of an analytical toolset to predict deficiencies in a Joint C4ISR architecture and to suggest solutions to those deficiencies.
- End-to-End testing to validate both the deficiencies and the solutions.

The JT&E is designed to validate the methodology. There are several elements to the JT&E:

1. Demonstrate that the data needed to execute the analytical toolset is available, current, and retrievable in a timely fashion.
2. Execute the predictive phase of the methodology (the analytical toolset) for a Joint C4ISR exercise architecture and compare predicted deficiencies with deficiencies observed during the exercise.
3. Demonstrate that predicted deficiencies and suggested solutions can be replicated in an end-to-end laboratory testing environment.
4. At the end of each exercise and after laboratory testing, adjust the parameters and algorithms in the toolset to match predicted with observed deficiencies.
5. Repeat for different Joint C4ISR architectures and exercises.
6. Deliver a validated and useful methodology to the warfighter.

Element 1 is designed to make sure the data is available to execute the toolset in time to be of use to the JFC. Elements 2 and 3 above are designed primarily to validate the methodology. Element 4 is a feedback process to improve the toolset, i.e. increase the accuracy of the predictions. Element 5 builds credibility into the methodology through multiple tests. Element 6 implies delivery of a validated and user-friendly product to the warfighter.

The methodology and a description of the analytical toolset are described in more detail below in Section 2.2.

The problem statement for the JCOBIAA JT&E was developed and refined through meetings with the JCOBIAA Operational Advisory Group (OAG), the JCOBIAA Senior Steering Group, and Warfighting CINCs and is as follows:

The Joint Task Force (JTF) Commander has insufficient means to identify deficiencies and solutions within the C4ISR architecture.

A deficiency is identified as an unacceptable level of risk of incompatibility, interoperability, or failure of necessary architecture components. From this problem statement, a set of issues and sub-issues were derived for this JT&E leading to a set of measures described in Section 2.3.

2.2 JCOBIAA METHODOLOGY

2.2.1 Overview

The JCOBIAA methodology is an analytical approach that combines risk-driven assessment, dynamic analysis, fine-grain analysis, and end-to-end testing to identify deficiencies and solutions for JTF C4ISR architectures. DoD has developed a framework (Framework 2.0) for building architecture products to understand the architecture structure and behavior. In the case of rapidly forming JTF's, the JTF architecture is large and complex and architecture products are not likely to have been created. The JCOBIAA team's approach uses risk assessment and dynamic analysis to prioritize issues and reduce the scope of the integrated architecture to be analyzed. The concept of functional threads (a unique path for information delivery) for task accomplishment is used as a mechanism for analysis. In addition, end-to-end testing is used to address problem areas like system interface compatibility and to identify solutions, since configuring actual hardware and software components in a distributed test environment can be more reliable than employing digital simulations.

2.2.2 Background

In today's dynamic and global environment, elements of the four Armed Services are often assembled for U.S. Military operations. Command and Control (C2) is normally accomplished by establishing a Joint Task Force (JTF), assigning a mission or objective to the Joint Force Commander (JFC), assigning or attaching appropriate forces to the joint force, and empowering the JFC with sufficient authority over the forces to accomplish the assigned mission.

The JFC must pull together disparate organizations and their underlying infrastructures to form a cohesive force. The JFC's staff uses Joint Doctrine, Joint Tactics, Techniques and Procedures (JTTP), and experience learned from previous JTFs to guide this effort. However, each JTF is different—it is built from the resources available at the time it is formed to deal with the particular assigned mission. The JFC needs to assess the fitness of the resulting Joint C4ISR architecture. The reality is that JTFs are formed rapidly with limited time available for assessing and enhancing the resulting JTF architecture. Evaluating the performance of architectures by linking specific tasks to individual C4ISR systems, processes, and organizations requires representing all the detailed processes involved. This could include tasks such as the transmission of communications across the battlefield, assessing the impact of intelligence collection on decision making, generating weapon fire control orders, and many others. Although architecture assessment tools continue to evolve, assessing an entire JTF architecture at a detailed level takes too long during crisis action planning prior to mission execution.

The NATO Code of Best Practice (COBP) for C2 assessment provides an evaluation framework and guidance for conducting C2 assessments. The COBP identifies a technique called "scanning the scenario space" using fast running systems dynamics models as a pre-filtering technique to identify high-interest segments of the architecture thread to explore further with fine-grain tools.

The JCOBIAA methodology has adopted the NATO COBP approach by using a coarse analytical tool as a "preprocessor" to identify risk areas across the *breadth* of the Joint C4ISR architecture. Then the methodology uses higher resolution tools and procedures to selectively analyze in more *depth* the high-risk areas identified by the coarser analytical tool. Finally, it identifies and recommends solutions that enhance capabilities or mitigate limitations of the architecture.

2.2.2.1 Joint Task Force Organization

The JFC determines the command relationship between components and their forces. For example, the Joint Force Land Component Commander (JFLCC) is responsible for planning and executing the ground campaign portion of the overall JTF operation. The role of each component commander in a joint force merits special attention. Component commanders are required to orchestrate the activity of their own forces, branches, and warfare communities. In addition, they must understand how their force integrates into the overall force structure to best support the JFC's plans and goals. Figure 2.1 shows the operational view of a notional JTF organized from the national, theater, force, and unit perspective. The resulting military operational organization generates a complex communication architecture with many interfaces and interactions, which need to be described from multiple perspectives to gain an understanding of the overall architecture's performance and the expected impact on military operations.

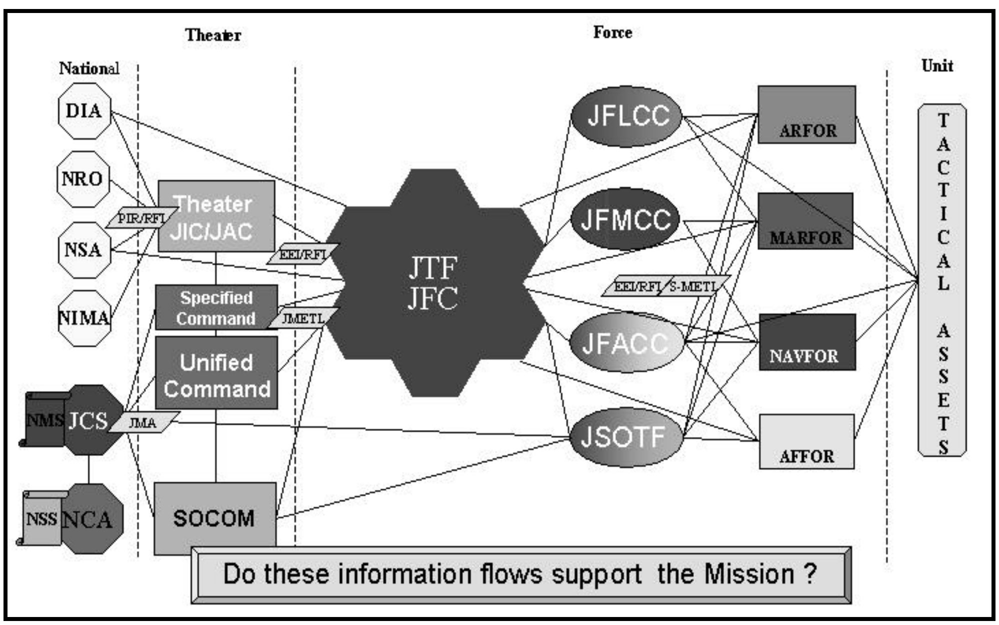


Figure 2.1 Operational View Of A Notional Joint Task Force

2.2.2.2 Joint Task Force Planning

"Deliberate" and "Crisis Action" are typical qualifiers of the process involved in conducting JTF planning and are depicted in Figure 2.2. The limited amount of time available for crisis action planning is the major difference between deliberate planning and crisis action planning. The phases in the planning process where the JTF architecture development process and the JCOBIAA JTF architecture assessment are conducted are also depicted in Figure 2.2.

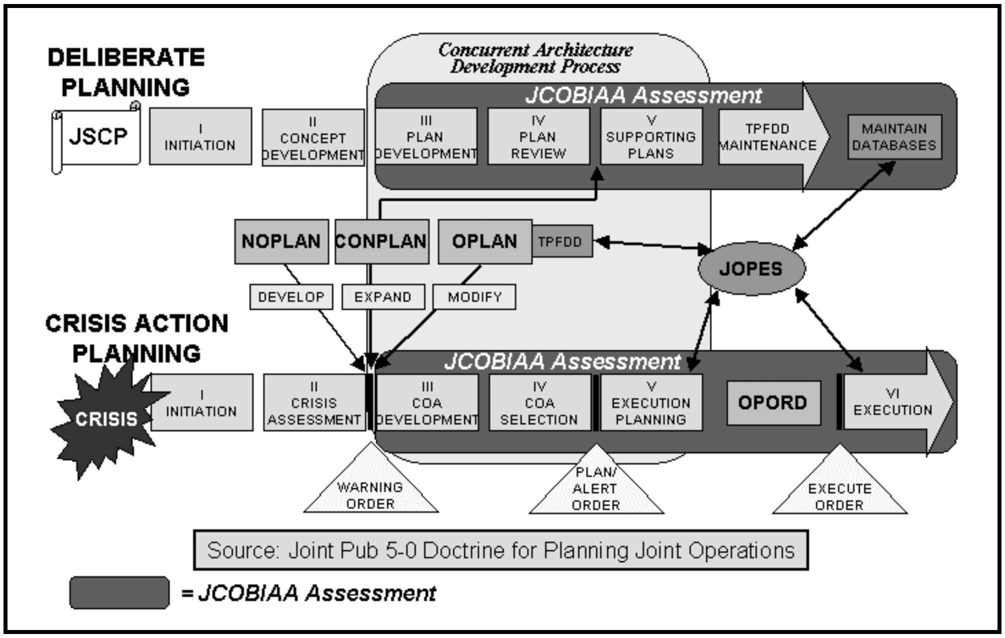


Figure 2.2 Joint Task Force Planning Summary

2.2.2.3 Integrated Architecture Challenge

The DoD describes various aspects of the Joint C4ISR architecture using the concept of architecture views. Three views of a single architecture are specified—the Operational, Systems, and Technical. The Operational view describes the required information exchanges to and from elements of the military organizations. In short, it describes who talks to whom and what information is passed between them. The Systems view describes the systems employed and the connections required in accordance with the military organizations specified in the Operational view. Finally, the Technical view describes the minimal set of standards and rules governing the implementation, arrangement, interaction, and interdependence of system elements. The Technical view facilitates increased interoperability and promotes efficiency. Figure 2.3 describes the DoD definition of an architecture. The JCOBIAA methodology focuses on the Operational and System views.

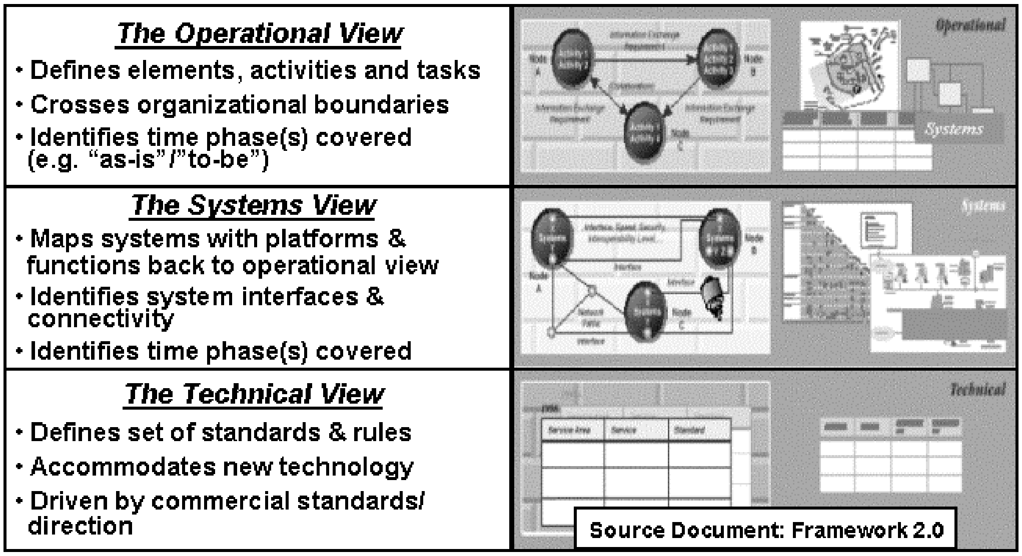


Figure 2.3 Definition Of An Architecture

Integrated architectures describe the single JTF design using these multiple views. Integrated architectures provide opportunities and challenges to improve mission execution. There is a functional challenge of how to array operational military personnel and staff organizations to make the best use of the architecture to accomplish the mission. There is the design challenge of how to specify the architecture so there is concordance between the views. There is the assessment challenge of how to determine the utility of a given architectural solution in terms of measures of performance and measures of effectiveness. Figure 2.4 shows the complexity of an integrated architecture displaying the three views of a notional JTF architecture.

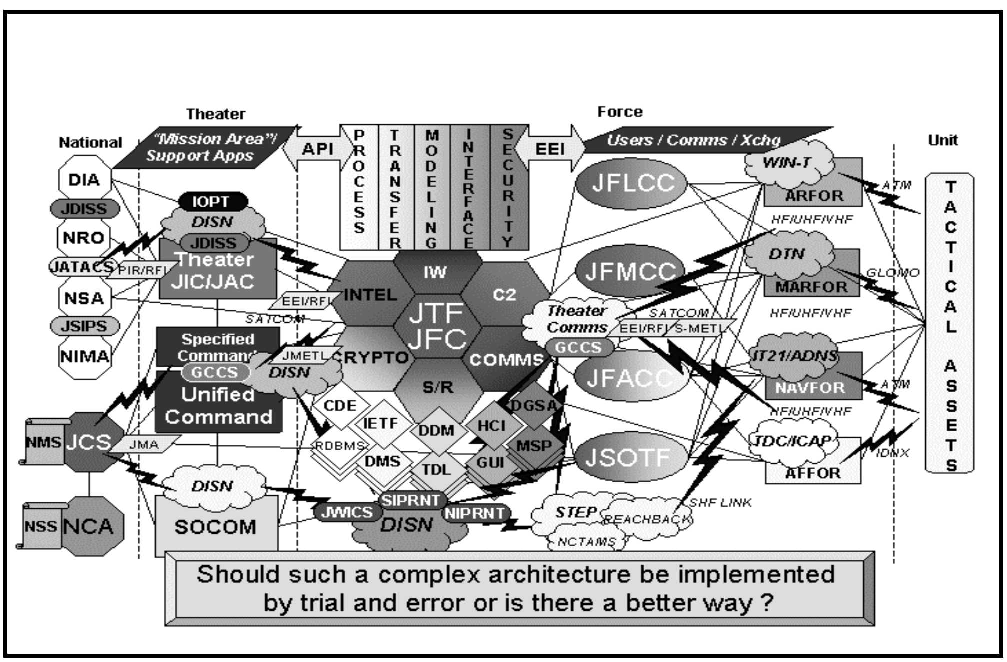


Figure 2.4 Integrated View Of A Notional JTF Architecture

2.2.3 Methodology

The JCOBIAA methodology is developed to address the architecture assessment problem and to reduce interoperability problems that are usually not discovered until the architecture is fielded or deployed. The basis of the methodology is to use a risk assessment tool to identify the highest priority or mission critical aspects of the JTF architecture and employ detailed analysis tools or actual hardware and software testing to further examine risk and identify risk mitigation procedures. The methodology will enable early assessment and reduce interoperability failures in the field. The methodology would primarily be conducted during the planning stages of JTF operations.

The JCOBIAA methodology uses risk assessment tools along with dynamic analysis, fine-grained analysis, and end-to-end testing to assess the JFC's Joint C4ISR architecture. The risk assessment tools identify high-risk areas that need to be examined in more detail. The objective is to suggest solutions to problems prior to the architecture being deployed thus saving time and expense. A pictorial view of the methodology is shown in Figure 2.5.

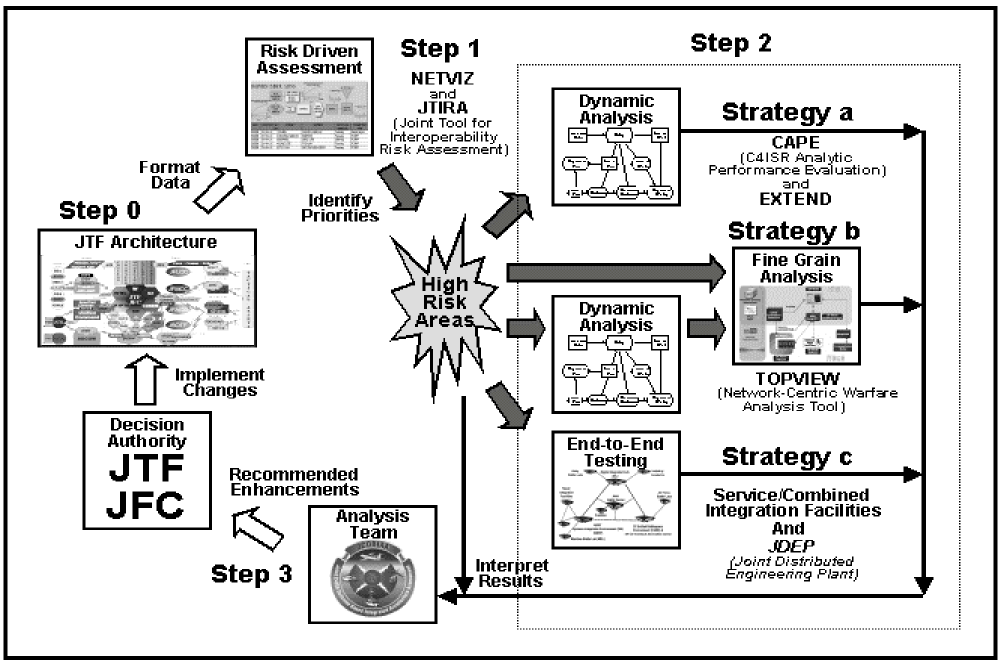


Figure 2.5 JCOBIAA Methodology Step-By-Step Example

2.2.3.1 Established JTF Architecture - Step 0

The process begins with a JTF architecture. The JTF architecture data, such as command relationship, force structure, and mission assignments, are formatted and used to conduct the risk assessment.

2.2.3.2 Risk Assessment – Step 1

Operational and integrated risk assessments are conducted by analysis of organizational relationships, systems, C2 and system interfaces, and the mission requirements (e.g. CSAR, CAS, TST, etc.). The risk assessment tools identify high-risk areas in the architecture that require further analysis.

- ***Operational Architecture Risk Assessment.*** The operational risk assessment looks across the breadth of the architecture. It will specifically compare the operational architecture elements with the JTF Representative C4ISR Operational Architecture (JRCOA) template and highlight missing and/or unconnected C2 nodes. These missing or unconnected nodes are the high-risk areas requiring further investigation. The JRCOA template is a JTF operational architecture template developed by USJFCOM JBC, based on Joint doctrine, and verified by USJFCOM subject matter experts.

- ***Integrated Architecture Risk Assessment.*** The integrated risk assessment looks across the breadth of the architecture pinpointing high-risk components of complex, integrated architectures and prioritizing testing. The integrated risk assessment includes: using functional threads drawn from mission essential task lists: organizing, tracking, and summarizing system inheritance data (e.g. failure rate, connectivity, etc.); mission criticality (e.g. exposure, contingency, etc.); and end-to-end testing performance into an interpretable risk value called the Risk Management Factor (RMF). The RMF is used to identify high-risk systems and connections. The risk is then defined as the probability of failure times the consequence of failure.

2.2.3.3 Analysis Process - Step 2

The high-risk areas are prioritized and classified for an appropriate analysis method, which can range from dynamic analysis to fine-grained analysis to end-to-end testing.

- ***Dynamic Analysis – Strategy a.*** The dynamic analysis assesses contributions of C4ISR systems and architectures to mission effectiveness. It also provides assessment of dynamic C4ISR parameters and their interactions.
- ***Fine-Grain Analysis – Strategy b.*** The fine-grain analysis provides detailed functional/mission thread analysis. This analysis includes: analyzing interrelationships between the operational view and systems view of integrated architectures; identifying performance characteristics/shortfalls of a Joint C4ISR architecture; and focusing the assessment on identified problem areas.
- ***End-To-End Testing – Strategy c.*** The end-to-end system performance testing connects and tests systems in their operational configuration identified in the Joint C4ISR architecture. This analysis is used to examine and evaluate the C4ISR systems and mission strings identified as having risk to the architecture.

2.2.3.4 The Assessment Results – Step 3

Once the analysis is completed, the results will be provided to the JTF staff. The identification of deficiencies and recommended solutions will be reviewed with recommendations to the JFC for implementation as necessary to the JTF architecture. The following is the expected analysis output from each step of the methodology:

- ***Operational Architecture Risk Assessment.*** Output from the operational risk assessment includes: identification of missing or unnecessary nodes (e.g. operational commands, components, tactical units, etc.); identification of missing or inappropriate mission-based information requirement threads and connections; and verification through doctrine and subject matter experts of the appropriate nodes and information flows.
- ***Integrated Architecture Risk Assessment.*** Output from the integrated risk driven assessment includes: probability of system deficiencies occurring; identification of the systems of high-risk associated to the assigned missions; and prioritization of system performance test requirements, including possible system configuration test combinations.

- ***Dynamic Analysis.*** Output from dynamic analysis includes: relationships between C4ISR systems, information flow (e.g. time, sequencing, etc.); optimal C4ISR architecture set up through comparison of system threads and measurement of C4ISR resource usage; and comparison of metrics (sensitivity analysis) and instrumentation options.
- ***Fine-Grain Analysis.*** Output from fine-grain analysis includes: detailed system-of-systems interactions, accuracy of information flow and mission thread timelines, and detailed metric comparisons and instrumentation combinations.
- ***End-To-End Testing.*** Output from end-to-end testing includes: uncertainty reduction in tested Joint C4ISR architecture configurations, identification of problems, identification of potential solutions, and validation of solutions.

As a minimum, the methodology allows the JFC to manage risk to the JTF architecture and prioritize the deficiencies in the Joint C4ISR architecture. Through further detailed analysis the JFC can confirm problem areas within the JTF architecture and identify solutions; reduce the number of interoperability problems within the JTF architecture; and have an optimized Joint C4ISR architecture prior to execution of the mission.

2.2.4 Architecture Assessment Tools

The JCOBIAA team has identified various tools for each step in assessing JTF architectures. These tools are Government Off-The-Shelf/Commercial Off-The-Shelf (GOTS/COTS) software tools that satisfy the requirements at each level of assessment. Detailed descriptions of the toolset are addressed in Appendix E.

For the risk driven assessment step, the following two tools will support the identification of high-risk areas across the breadth of a C4ISR architecture.

- ***NETVIZ.*** For operational architecture risk assessment, NETVIZ is a network visualization tool that graphically records physical and logical relationships between networks, systems, and processes. It will assemble and analyze key nodal relationships through database comparisons.
- ***JTIRA.*** For integrated architecture risk assessment, Joint Tool for Interoperability Risk Assessment (JTIRA) is an interoperability risk assessment tool that will identify high-risk areas using functional threads drawn from essential force capabilities. It will organize, track, and summarize system data and test results into an interpretable risk value or risk management factor (RMF).

For system dynamic analysis, the *Extend* and *Analytica* software engines (see Appendix E) are used to support the following process tools.

- ***CAPE.*** For system dynamic analysis, C4ISR Analytic Performance Evaluation (CAPE) is an analytic performance tool that will evaluate C4ISR architectures and alternatives. It is a quick-look tool that will conduct rapid assessments of architecture functional areas (e.g. CSAR, CAS, etc.).
- ***TOPVIEW.*** For both dynamic and fine-grain analysis, TOPVIEW is a network-centric warfare performance analysis tool that will tie operational concepts (e.g. CONOPS, Joint doctrine, etc.) with system architectures and technical performance.

For fine-grain analysis, *Extend* and *OPNET* software (see Appendix E) are used to support the following assessment tools.

- ***TOPVIEW.*** For both dynamic and fine-grain analysis, TopView is a network-centric warfare performance analysis tool that will tie operational concepts (e.g. CONOPS, Joint doctrine, etc.) with system architectures and technical performance.
- ***NETWARS.*** For fine-grain analysis, Network Warfare Simulation (NETWARS) is a Joint C4 network assessment tool that will measure and assess through a system modeling engine (e.g. OPNET) the information flow through military communications networks.

End-to-End testing is used for actual hardware and software connections for a definitive understanding of system performance and problems. The process and environments used for end-to-end testing include resources of the Federated Battle Laboratories. Details of the tool selection criteria and tool descriptions are provided in Appendix E.

2.2.5 Summary

This section has outlined an integrated architecture assessment methodology that the JCOBIAA study team has investigated. The goal is an assessment methodology that can be used to get results quickly as a JTF is forming. The methodology builds on the NATO COBP for C2 Assessment by adding risk assessment as a mechanism for narrowing the scope of the architecture that needs to be analyzed or tested. The objective is to identify deficiencies and solutions in the architecture before problems arise in the field. Figure 2.6 is a summary of the JCOBIAA methodology process compared to the current assessment process.

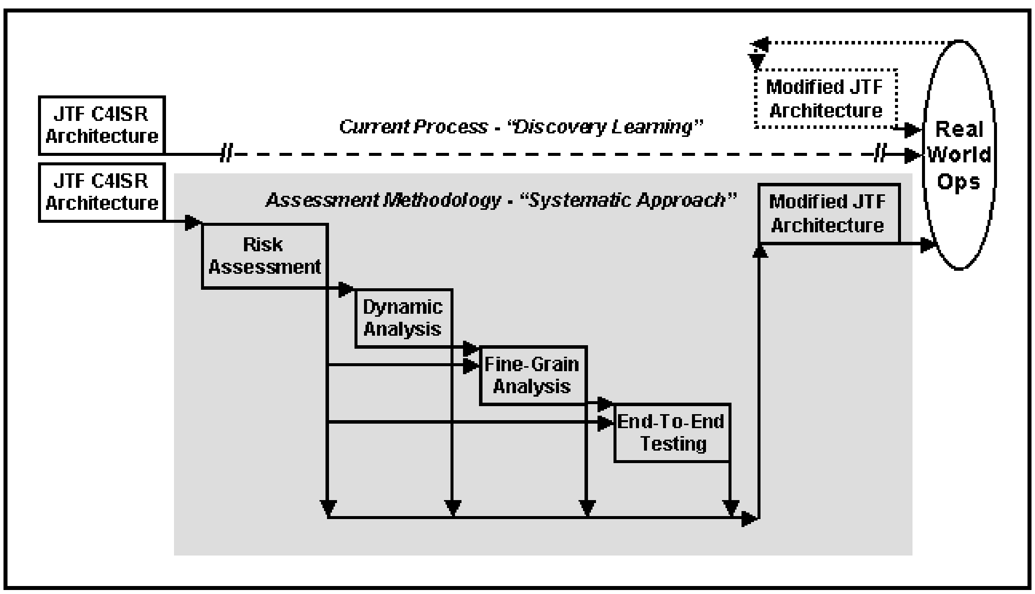


Figure 2.6 Assessment Methodology Summary

The team's study of architecture assessment has confirmed that there is no single tool, which can provide a total assessment. This is why the methodology includes multiple tools.

The JCOBIAA methodology offers an opportunity for C4ISR architecture assessment that will prove valuable to solving the JFC's immediate and most critical problem of assembling disparate organizations and their underlying infrastructures to form an effective fighting force.

2.3 ISSUES AND MEASURES

This section describes the issues that form the basis for this JT&E and the measures selected to evaluate the resolution of those issues. The overall approach and test focus is shown in Figure 2.7. This approach uses data from the integrated JTF architecture design as modified by the dynamics of a JTF situation. The test focus is a broad list because the data collection, user interfaces and method validation are all key areas requiring formal evaluation and ultimate integration. Four main issues frame the test purpose, which is to test and validate a methodology to identify deficiencies and solutions to those deficiencies within the Joint C4ISR architecture of a JTF. The article under test, therefore, is the JCOBIAA methodology. The test resources are various Joint C4ISR architectures, selected to represent critical JTF characteristics.

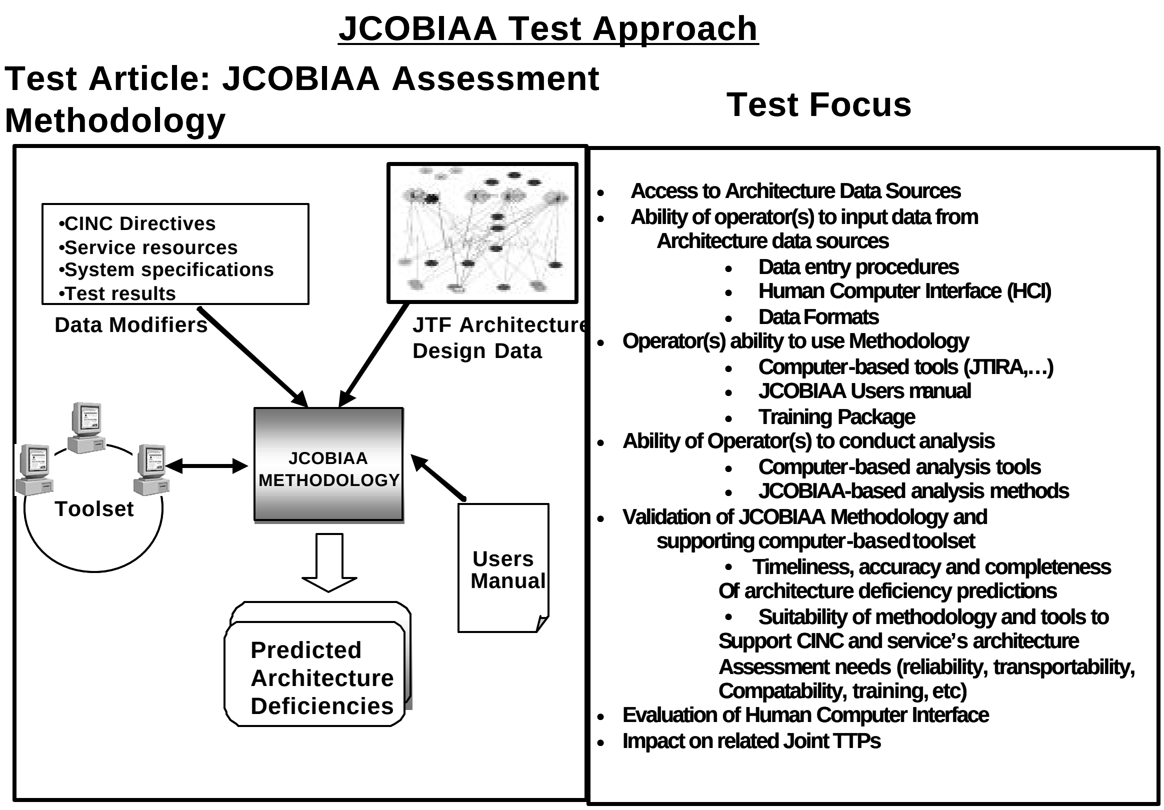


Figure 2.7 JCOBIAA Method and Test Focus

2.3.1 Issues

The four main issues for the JT&E are:

- **Issue 1.0:** How timely, accurately, and completely can the analytical toolset be populated with the required C4ISR architecture information?
- **Issue 2.0:** How timely, accurately, and completely does the methodology identify deficiencies in the JTF C4ISR architecture?
- **Issue 3.0:** How timely, accurately, and completely does the methodology identify solutions to predicted deficiencies in the JTF C4ISR architecture?
- **Issue 4.0:** How suitable is the methodology for use by the warfighter?

2.3.2 Sub Issues

From these issues, a further breakdown into sub issues helps to partition the test so that metrics, in the form of Measures of Effectiveness and Performance (MOEs and MOPs) can be assigned. For Issue 1.0, the "data" being collected is operational, system, and technical characteristics, used by the analytical tools, and described in Appendix G. A majority of this data is initially derived from the JTF planning process itself. The crisis to which the JTF is responding will dictate JC4ISR operational designs and resource selections. Inputs to such documents as the Warning Order, the Operations Order (OPORD), Joint Operation and Deployment Schedules (JOPES), and the communication network plans will be the initial data sources. Based on this initial data collection, additional data will be collected using the data mining scheme, described in Appendix F, to expand and update the architecture's attributes. Sub-issue breakdowns are:

- **Issue 1.0:** How timely, accurately, and completely can the analytical toolset be populated with the required C4ISR architecture information?
- **Sub-Issue 1.1** Can the data requirements of the JCOBIAA Methodology be identified for the architecture being assessed? This Sub-Issue recognizes that design detail required by the toolset may be both inconsistent and immature, which will affect the timeliness, accuracy and completeness of data collection required to initialize the JCOBIAA tools.
- **Sub-Issue 1.2** Can the data for the JCOBIAA Toolset be obtained from the approved sources for the architecture being assessed? This Sub-Issue addresses the mining of data to complete the assessment data requirements.
- **Sub-Issue 1.3** How interchangeable is the required data among the levels of the JCOBIAA Methodology? This Sub-Issue addresses the usability of the data collected for the architecture assessment to determine if it can be used by each tool that requires that data without significant format changes. (note: levels refers to both the different tools and to levels of more granularity in the tools themselves)
- **Sub-Issue 1.4** Is the time needed to populate the analytical toolset with the required C4ISR architecture information adequate to allow an assessment to be conducted? Since time is a key feature, based on the JTF type, two divisions are considered.
    - **Sub-Sub-Issue 1.4.1 –** For Deliberate Planning JTFs
    - **Sub-Sub-Issue 1.4.2 –** For Crisis Action Planning JTFs
- **Sub-Issue 1.5** Is the architecture environment, design, and system attribute data correct and accurate enough for the toolset requirements. This issue addresses the state where incorrect or missed predictions could be corrected with more accurate data.
- **Sub-Issue 1.6** Is the architecture's envisioned employment environment, design, and system attribute data complete enough for the toolset requirements. This issue addresses cases where observed deficiencies not predicted could have been properly diagnosed with additional data appropriate for the toolset - completeness error rate.
- **Issue 2.0:** How timely, accurately, and completely does the methodology identify deficiencies and areas of increased risk in the JTF C4ISR architecture?
- **Sub-Issue 2.1** Does the methodology identify predicted deficiencies and areas of increased risk in sufficient time for the JTF Commander to take appropriate actions to mitigate or resolve?
    - **Sub-Sub-Issue 2.1.1 -** Does the methodology identify specific deficiencies in sufficient time for the JTF Commander to take appropriate actions to mitigate or resolve?

        - **Sub-Sub-Issue 2.1.2 -** Does the methodology identify areas of increased risk in sufficient time for the JTF Commander to take appropriate actions to mitigate or resolve?
- **Sub-Issue 2.2** Does the assessment methodology provide an accurate and correct identification of C4ISR deficiencies?
    - **Sub-Sub-Issue 2.2.1 -** Do the predicted deficiencies, provided by the assessment methodology, accurately specify the actual cause of the C4ISR architecture deficiencies?
    - **Sub-Sub-Issue 2.2.2 -** Do the predicted deficiencies, provided by the assessment methodology, correctly identify actual C4ISR architecture deficiencies?
- **Sub-Issue 2.3** Does the methodology provide a comprehensive and effective assessment of the C4ISR architecture?
    - **Sub-Sub-Issue 2.3.1 -** Does the Methodology assess the capability of a C4ISR architecture design to satisfy the tasked missions?

The assessment categories are based on the USJFCOM Joint C4ISR Battle Center (JBC) C4ISR Assessment Handbook (derived from the JCATE JT&E JFS) and modified for this project. An array of the requirements for the JTF C4ISR networks derived from doctrinal references substantiate the categories chosen for the methodology assessment. This cross-reference approach was taken to ensure that the methodology assesses the features of a JTF architecture that are considered important by the users. Accordingly, the warfighter must have C4ISR systems that are interoperable, flexible, responsive, mobile, disciplined, survivable, and sustainable. (Reference Joint Pub 6.0 and 3-55) The communication network of a JTF is one which will be capable of rapidly deploying and employing with designated forces in response to worldwide contingencies in an underdeveloped operational or theater area. It requires a full range of responsive, secure, and non-secure communications systems to ensure positive Command and Control (C2) during each critical phase of contingency operations. These systems must provide rapid, secure, and reliable voice, data, and message communication services throughout the joint operations area (JOA). (Reference CJCSM 6231.01A) The information exchanged will have attributes of: accuracy (information that conveys the true situation), relevancy (information that applies to the mission, task, or situation at hand), timeliness (information that is available in time to make decisions), usability (information that is in common, easily understood format and displays), completeness (all necessary information required by the decision maker), briefness (information that has only the level of detail required) and security (information that has been afforded adequate protection where required) (Reference JP 5-00.2). Cross referencing the test handbook and the cited references as requirements, the following sub-issues were selected to "completely" assess the JTF architecture:

- Accessible (Relevant and timely)
- Accurate
- Adaptable (Responsive and flexible)
- Complete
- Capacity (to accomplish the mission)
- Interoperability (Joint, Service, Coalition, Allied, Civil)
- Mobility
- Reliable, Maintainable, Available

- Robustness (flexible, survivable)
- Security

This list of Sub-Issues (Sub-Sub-Sub-Issues) can be further described to help understand the assessment focus required of the methodology.

- **Sub-Sub-Sub-Issue 2.3.1.1 -** Does the methodology correctly assess the architecture to provide the mission requirements for accessibility? Accessibility is defined as having the information needed by the selected mission area or function, received in time, and at the requested location.
- **Sub-Sub-Sub-Issue 2.3.1.2 -** Does the methodology correctly assess the architecture to provide the mission requirements for accuracy? Accuracy is defined as having the required information provided for this selected mission area or function correct. Correct information is that information that reflects the actual situation (ground truth).
- **Sub-Sub-Sub-Issue 2.3.1.3 -** Does the methodology correctly assess the architecture to provide the mission requirements for adaptability? Adaptability is defined as the ability to adapt to changes in technology and to intelligently adjust to compensate for shortfall in capability.
- **Sub-Sub-Sub-Issue 2.3.1.4 -** Does the methodology correctly assess the architecture to provide for the mission requirements for completeness? Completeness is defined as the tasks required of the C4ISR architecture, by the selected mission area or function, that it is able to support successfully.
- **Sub-Sub-Sub-Issue 2.3.1.5 -** Does the methodology correctly assess the architecture to provide for mission requirements for capacity? Capacity is defined as providing the required information to the required nodes in the required time for the selected mission area or function.
- **Sub-Sub-Sub-Issue 2.3.1.6 -** Does the methodology correctly assess the architecture to provide for mission requirements for interoperability? Interoperability is defined as the capability to facilitate direct and satisfactory exchange of information or services between and among C4ISR systems and/or pieces of equipment and/or procedures in Joint, Allied/Coalition, interagency and commercial environments.
- **Sub-Sub-Sub-Issue 2.3.1.7 -** Does the methodology correctly assess the architecture to provide for mission requirements for mobility? Mobility is defined as the impact of the portability/transportability characteristics on the mission requirements.
- **Sub-Sub-Sub-Issue 2.3.1.8 -** Does the methodology correctly assess the architecture to provide for mission requirements for reliability, maintainability and availability (RMA)? RMA is defined

as possessing the required RMA dictated by the selected mission areas or functions and scoped to key systems as defined in the architecture.

        - **Sub-Sub-Sub-Issue 2.3.1.9 -** Does the methodology correctly assess the architecture to provide for mission requirements for robustness? Robustness is defined as the ability to provide capabilities required by the selected mission area or function when degraded conditions are present.
        - **Sub-Sub-Sub-Issue 2.3.1.10 -** Does the methodology correctly assess the architecture to provide for mission requirements for security? Security is defined as the capability of providing for accessing, processing, and distributing multi-level secure data without unauthorized disclosure or intrusion.
    - **Sub-sub-Issue 2.3.2 -** Does the Methodology provide an effective (value-added) assessment, which identifies the JTF mission-critical deficiencies? Mission critical deficiencies are those, which the JFC determines he must correct prior commencing operations or if he is unable to correct, he must change his operational plan.

- **Issue 3.0:** How timely, accurately, and completely does the methodology identify solutions to predicted deficiencies in the JTF C4ISR architecture? Since the JTF has not been deployed or may have only a partial infrastructure in place, solutions are unlikely to be implemented and assessed except through mockup and laboratory or surrogate configurations. The JT&E will have both laboratories and field exercise opportunities to implement and verify solutions. Solutions to architecture deficiencies are a combination of analytical tool outputs and opinions of operational expertise assigned to the assessment team.

- **Sub-Issue 3.1** Does the methodology provide solutions to predicted deficiencies in sufficient time to allow implementation by the JTF?
- **Sub-Issue 3.2** Does the methodology provide recommended solutions to solve deficiencies without corrupting the architecture in another area?
    - **Sub-Sub-Issue 3.2.1 -** Do implemented solutions correct the deficiency they are intended to solve?
    - **Sub-Sub-Issue 3.2.2 -** Do implemented solutions that correct corresponding deficiencies cause a deficiency in another area?
- **Sub-Issue 3.3** Does the methodology recommend solutions for all deficiencies?

- **Issue 4.0:** How suitable is the methodology for the warfighter? This issue addresses the suitability of the toolset to be used by the warfighters and those operational planners whose job it is to assemble and assess the JTF architecture. Assessment data will be collected during the toolset data population stage and assessment runs for the JCOBIAA JT&E events. Additional features such as supportability and training requirements will be addressed here.
- **Sub-Issue 4.1 –** How useable is the methodology and supporting toolset for the trained operational user under operational conditions?

- **Sub-Sub-Issue 4.1.1** - Is Methodology-directed collection of data by the assessment team an efficient process to identify and enter that data into the toolset?
    - **Sub-Sub-Sub-Issue 4.1.1.1** - Are data identification procedures efficient?
    - **Sub-Sub-Sub-Issue 4.1.1.2** - Is the Human-Computer Interface (HCI) for data entry adequate?
    - **Sub-Sub-Sub-Issue 4.1.1.3** - Is the data format consistent across the toolset?
    - **Sub-Sub-Sub-Issue 4.1.2.4 –** Does the Methodology provide sufficient guidelines foe the collection of required C4ISR data?
- **Sub-Sub-Issue 4.1.2** - Is the methodology designed to be adequate for the typical operator's ability?
    - **Sub-Sub-Sub-Issue 4.1.2.1** - Are the computer-based tools easy to use by the trained operator?
    - **Sub-Sub-Sub-Issue 4.1.2.2** - Does the JCOBIAA Users Manual provide instructions that allows the typical operator to complete all described functions?
    - **Sub-Sub-Sub-Issue 4.1.2.3** - Does the JCOBIAA training package provide for the typical operator information that allows the operator to use the methodology with no errors?
    - **Sub-Sub-Issue 4.1.3** - Can the typical operator(s) conduct an analysis of the design of a JTF C4ISR architecture in an operational environment?
    - **Sub-Sub-Sub-Issue 4.1.3.1** - Are the computer-based analysis tools that make up the toolset useable by the operator?
    - **Sub-Sub-Sub-Issue 4.1.3.2 -** Can the JCOBIAA-developed analytical methods be used by the operator?
- **Sub-Issue 4.1.4** - Is the JCOBIAA toolset useable under all anticipated operational conditions?
- **Sub-Issue 4.1.5 –** Can the team of users produce an assessment of a JTF architecture in the time required by the JTF commander?

- **Sub Issue 4.2 –** Is the toolset supportable by the intended users? (in terms of skill levels required, maintenance, and cost)

2.3.3 Measures

The Measures of Effectiveness (MOEs) and Performance (MOPs) and the data elements have been added to the associated issue. Criteria for the measures have also been added which matches the decomposition of the issues and supports the goal of the Methodology to provide a timely, accurate and complete assessment of the JTF architecture. It should be noted that effectiveness is not quantified by a number of deficiencies. Those subject matter experts and decision makers who are expected to use the architecture will rate the effectiveness. Under this scenario, mission critical risk identification and specific deficiencies are expected to carry more weight than total number. If data is not identified or collected, surrogate data will be supplied (with an appropriate risk due to an unknown status) so that the tool will run.

Issue 1.0: How timely, accurately, and completely can the analytical toolset be populated with the required C4ISR architecture information?		
Sub-Issue 1.1 Can the data requirements of the JCOBIAA Methodology be identified for the architecture being assessed?		
Criteria: All of data elements required by methodology (data profile) can be identified for the architecture being assessed. Data required by the toolset, but not identified as to its location does not prevent mission-critical architecture deficiencies* from being identified. (*mission-critical architecture deficiencies are those which the JTF Commander determines must be corrected or if unable to correct, for which effected operations must be changed to mitigate the deficiency)		
MOE	1.1	Ratio of observed (but not predicted) deficiencies who's characterizing data was in the required data profile to total observed (but not predicted) (1.1.1.4/1.1.1.3)
MOP	1.1.1	Ratio of the number of identified data elements to the number required by the methodology
Data	1.1.1.1	Number of data elements identified
Data	1.1.1.2	Number of data elements required
Data	1.1.1.3	Number of observed but unpredicted deficiencies
Data	1.1.1.4	Number of observed but unpredicted deficiencies with characterizing data in the Methodology's required data profile
Sub-Issue 1.2 Can the data for the JCOBIAA Toolset be obtained from the approved sources for the architecture being assessed?		
Criteria: All identified data can be collected/ updated from the approved/designated source. Failure to collect/update data does not prevent critical architecture deficiencies or high-risk areas from being identified.		
MOE	1.2	Ratio of observed (but not predicted) deficiencies who's characterizing data was in the required data profile, but not collected, to total observed (but not predicted) (1.2.1.4/1.2.1.3)
MOP	1.2.1	Ratio of collected data to identified data for the toolset
Data	1.2.1.1	Number of data elements identified
Data	1.2.1.2	Number of data elements collected from authorized sources
Data	1.2.1.3	Number of observed but unpredicted deficiencies
Data	1.2.1.4	Number of observed but unpredicted deficiencies with characterizing data identified but not collected
Sub-Issue 1.3 How interchangeable is the required data among the levels of the JCOBIAA Methodology?		
Criteria: Optimum goal is that all data is transferable across all tools. Acceptable is that no time penalty to reformat data between tools effects quality of assessment. (note: levels refers to the levels of granularity of the tools, whether it is between different tools or in more detailed applications using the same tool.)		
MOE	1.3	Format error rate when collected data used throughout the toolset
MOP	1.3.1	Mean time penalty to reformat data used between tool applications

Data	1.3.1.1	Elapsed time required to re-format data used by tool
MOP	1.3.2	Percent data re-formatted per tool
Data	1.3.2.1	Data elements reformatted by tool
Data	1.3.2.2	Total data elements used by tool
Data	1.3.2.3	Number of format errors
Sub-Issue 1.4 Is the time needed to populate the analytical toolset with the required C4ISR architecture information adequate to allow an assessment to be conducted?		
Sub-sub-Issue 1.4.1 – For deliberate JTFs		
Criteria: Time to populate the toolset with data does not affect the quality of the assessment, as rated by the JTF Commander or his designated representative. (note: individual and total times will be collected)		
MOE	1.4.1	Mean of time to populate toolset to allow for an assessment to be conducted for deliberate JTFs
MOP	1.4.1.1	Percent of time available to used by the methodology
Data	1.4.1.1.1	Time to populate toolset with data
Data	1.4.1.1.2	Time to conduct assessment
Data	1.4.1.1.3	Time available to JTF for assessment
Sub-sub-Issue 1.4.2 – For crisis planning JTFs		
Criteria: Time to collect data allows a value-adding assessment* to be conducted according to the CJTF's schedule for deployment. (*value-adding assessment is a subjective determination by the CJTF that the assessment reduced risk by identifying critical deficiencies in the architecture and/or areas of high risk to mission success)		
MOE	1.4.2	Mean time to populate toolset to allow for an assessment to be conducted for crisis planning JTFs
MOP	1.4.2.1	Percent of time available to that used by the methodology
Data	1.4.2.1.1	Time to populate toolset with data
Data	1.4.2.1.2	Time to conduct assessment
Data	1.4.2.1.3	Time available to JTF for assessment
Sub-Issue 1.5 Is the architecture environment, design and system attribute data collected correct and accurate enough for the toolset requirements?		
Criteria: A confidence factor can be established for data to prevent inaccurate or incorrect data, from identifying critical architecture deficiencies or high-risk areas. This issue attempts to quantify how the tool compensates for the accuracy and level of detail the data mining scheme is capable of accomplishing. It associates that measure with the observed results. It also addresses the confidence in the correctness of data collected and that impact on the assessment.		
MOE	1.5	Ratio of predicted deficiencies rated as incorrect who's characterizing data was determined to be inaccurate or incorrect
MOP	1.5.1	Data error rate
Data	1.5.1.1	Data elements collected, estimated by sampling, to be incorrect, by type and source
Data	1.5.1.2	Total data elements collected
MOP	1.5.2	Data accuracy error rate
Data	1.5.2.1	Data elements collected of required accuracy by type and source
Data	1.5.2.2	Total data elements collected

Data	1.5.2.3	Number of predicted deficiencies rated as incorrect/ inaccurate
Sub-Issue 1.6 Is the architecture environment, design and system attribute data collected complete enough for the toolset requirements?		
Criteria: Missing data, which the toolset could have used in an assessment, does not prevent critical architecture deficiencies or high-risk areas from being identified. This issue has two components. Is the mining scheme robust enough and can the tool compensate for deficiencies in data requirements. (note: a feedback loop from this measure is one of the methods to improve the toolset)		
MOE	1.6	Ratio of observed deficiencies who's characterizing data was not collected, not identified or not in the Methodology data profile
MOP	1.6.1	Incomplete data error rate
Data	1.6.1.1	Number of observed deficiencies that could have been discovered or predicted with additional toolset data.
Data	1.6.1.2	Total number of verified deficiencies predicted by the toolset
Data	1.6.1.3	Total observed deficiencies
Issue 2.0: How timely, accurately, and completely does the methodology identify deficiencies and areas of increased risk in the JTF C4ISR architecture?		
Sub-Issue 2.1 Does the methodology identify predicted deficiencies and areas of increased risk in sufficient time for the JTF Commander to take appropriate actions?		
Sub-sub-Issue 2.1.1 Does the methodology identify specific deficiencies in sufficient time for the JTF Commander to take appropriate actions to mitigate or solve?		
Criteria: Time to identify specific deficiencies allows verification and correction IAW the JTF's timeline of operations. The use of Subject Matter Experts (SMEs) will determine these criteria. The definition of sufficient time is based on the initial time of employment. Test events will extrapolate capabilities for use after operations begin.		
MOE	2.1.1	Adequacy of time required to identify specific deficiencies
MOP	2.1.1.1	Percent of deficiencies identified in time to allow verification and correction before needed
Data	2.1.1.1.1	Time to identify deficiency
Data	2.1.1.1.2	Time to verify and correct deficiency
Data	2.1.1.1.3	Time correction required
Sub-sub-Issue 2.1.2 Does the methodology identify areas of increased risk in sufficient time for the JTF Commander to take appropriate actions to mitigate or solve?		
Time to identify areas of increased risk allows time for investigation to isolate the deficiency, verification and correction IAW the JTF's timeline of operations or a minimum a quarantine to isolate the impact to operations.		
MOE	2.1.2	Adequacy of time to identify areas of increased risk
MOP	2.1.2.1	Percent of areas of increased risk identified in time to allow isolation of specific problem, verification, and correction before needed
Data	2.1.2.1.1	Time to identify area of increased risk
Data	2.1.2.1.2	Time to verify, isolate and correct deficiency
Data	2.1.2.1.3	Time correction required
Sub-Issue 2.2 Does the assessment methodology provide an accurate and correct identification of C4ISR deficiencies?		

Sub-sub-Issue 2.2.1 Do the predicted deficiencies, provided by the assessment methodology, accurately specify the actual cause of the C4ISR architecture deficiencies?		
Criteria: All specifically identified deficiencies are accurately enough described to incur a minimal time to verify		
MOE	2.2.1	Accuracy of assessment methodology
MOP	2.2.1.1	Percent of deficiencies identified which were too inaccurately defined to verify without further diagnostic effort
Data	2.2.1.1.1	Number of deficiencies identified
Data	2.2.1.1.2	Number of identified deficiencies requiring further investigation and assessment before verification possible
Sub-sub-Issue 2.2.2 Do the predicted deficiencies, provided by the JCOBIAA assessment methodology, correctly identify actual C4ISR architecture deficiencies?		
Criteria: No predicted, critically-rated deficiencies are assessed as incorrectly identified		
MOE	2.2.2	Correctness of assessment methodology
MOP	2.2.2.1	Incorrect identification rate
Data	2.2.2.1.1	Total number of deficiencies identified
Data	2.2.2.1.2	Number of identified deficiencies rated as incorrect (note: verification and/or further diagnostic efforts unsuccessful)
Sub-Issue 2.3 Does the methodology provide a comprehensive and effective assessment of the C4ISR architecture?		
Sub-sub-Issue 2.3.1 Does the Methodology assess the capability of a Joint C4ISR architecture design to satisfy the tasked missions?		
Sub-sub-sub-Issue 2.3.1.1 Does the methodology correctly assess the architecture to provide the mission requirements for Accessibility		
Criteria: The assessment methodology identifies all deficiencies/areas of risk related to accessibility		
MOE	2.3.1.1	Effectiveness of the methodology in assessing the capability of the architecture design to get information needed by [selected mission area or function] in time at the requested location. *Methodology approach: Rate mission-specific information sender-to-receiver system and link compatibilities with the probability of receipt within time requirements dictated by mission.*
MOP	2.3.1.1.1	Percentage of observed information sources identified for selected mission area or function
Data	2.3.1.1.1.1	Number of mission-required information sources identified by the toolset
Data	2.3.1.1.1.2	Number of mission-required data sources observed
MOP	2.3.1.2	Percentage of accurate link quality predictions
Data	2.3.1.2.1	Link quality prediction from information sources to requester
Data	2.3.1.2.2	Link quality measurements from information sources to requester.
MOP	2.3.1.3	Percentage of accurate transfer time assessments to meet selected mission area or function requirements
Data	2.3.1.3.1	Information transfer time adequacy assessment

Data	2.3.1.3.2	Information transfer time measurement
Sub-sub-sub-Issue 2.3.1.2 Does the methodology correctly assess the architecture to provide the mission requirements for Accuracy		
Criteria: The JCOBIAA assessment methodology identifies all deficiencies/areas of risk related to accuracy.		
MOE	2.3.1.2	Effectiveness of the methodology to assess the capability of the architecture design to acquire and transfer required information that is correct. Correct information is that information that reflects the actual situation (ground truth) required for this [selected mission area or function]. *Methodology approach: Rate information accuracy from source (probability of detection, coverage, revisit rate, resolution, medium, threats) to destination (processing delay, error rate). Compare to mission requirements (time, resolution)*
MOP	2.3.1.2.1	Ratio of predicted to measured **key systems/process** data error rate for this [selected mission area or function].
Data	2.3.1.2.1.1	Predicted **key systems/process** data error rate
Data	2.3.1.2.1.2	Measured **key systems/process** data error rate
MOP	2.3.1.2.2	Ratio of predicted to measured error detection and elimination capabilities for **key systems/processes** of this [selected mission area or function]
Data	2.3.1.2.2.1	Predicted error detection and correction rate
Data	2.3.1.2.2.2	Measured error detection and correction rate
MOP	2.3.1.2.3	Ratio of predicted to measured data corruption values for **key systems/processes**
Data	2.3.1.2.3.1	Predicted data corruption value for **key systems/processes**
Data	2.3.1.2.3.2	Measured data corruption value for **key systems/processes**
MOP	2.3.1.2.4	Ratio of predicted to measured user's confidence rating in the accuracy of the information associated with this **key systems/processes** when associated with [selected mission area or function]
Data	2.3.1.2.4.1	Predicted user's confidence of information accuracy at **key systems/processes.**
Data	2.3.1.2.4.2	Measured user confidence rating in information accuracy at **key systems/processes.**
MOP	2.3.1.2.5	Ratio of predicted to measured information transfers which meet mission requirement for this [selected mission area or function]
Data	2.3.1.2.5.1	Predicted timeliness of information to be transferred across

		this architecture to support this [selected mission area or function]
Data	2.3.1.2.5.2	Measured timeliness of information to be transferred across this architecture to support this [selected mission area or function]
Sub-sub-sub-Issue 2.3.1.3 Does the methodology correctly assess the architecture to provide the mission requirements for Adaptability		
Criteria: The JCOBIAA assessment methodology identifies all deficiencies/ areas of risk related to adaptability		
MOE	2.3.1.3	Effectiveness of the methodology to assess the capability of the architecture design to adapt to changes in technology and to intelligently adjust to compensate for shortfalls in capability. *Methodology Approach: Rate systems on legacy and open protocols compatibility, fielding date and operator skill requirements*
MOP	2.3.1.3.1	Ratio of predicted to measured **key systems/processes** that were able to adapt to realistic mission or technology changes and accomplish their mission.
Data	2.3.1.3.1.1	Predicted capability of **key systems/processes** to adapt and function under changing mission conditions
Data	2.3.1.3.1.2	Measured capability of **key systems/processes** to adapt and function under changing mission conditions (same used in prediction)
MOP	2.3.1.3.2	Ratio of predicted to measured **key systems/processes** that gracefully degraded under stress.
Data	2.3.1.3.2.1	Prediction of **key systems/ processes** with capability/ compatibility to change to compensate for deficiencies or shortfalls in the operating environment.
Data	2.3.1.3.2.2	Count of **key systems/ processes** which exhibit successful capability/ compatibility to change to compensate for deficiencies or shortfalls in the operating environment.
Sub-sub-sub-Issue 2.3.1.4 Does the methodology correctly assess the architecture to provide the mission requirements for completeness		
Criteria: The JCOBIAA assessment methodology identifies all deficiencies/ areas of risk related to completeness		
MOE	2.3.1.4	Effectiveness of the methodology to assess the capability of the architecture design to successfully support tasks required by [selected mission area or function] *Methodology Approach: Rate mission completion risk by combining risk to task completion (system, subsystem, link*

		degradation or failure, error rates, time requirements)
MOP	2.3.1.4.1	Ratio of predicted to measured completed task(s) supported by this C4ISR architecture for this [selected mission area or function]
Data	2.3.1.4.1.1	Predicted completion rating for tasks required by [selected mission area or function]
Data	2.3.1.4.1.2	Measured completion rating for tasks required by [selected mission area or function]
MOP	2.3.1.4.2	Goodness of fit ratio between predicted and measured process and activity times for [selected mission area or function]
Data	2.3.1.4.2.1	Predicted time(s) to accomplish C4ISR activities and processes which support tasks required by [selected mission area or function]
Data	2.3.1.4.2.2	Measured time(s) to accomplish C4ISR activities and processes which support tasks required by [selected mission area or function]
Sub-sub-sub-Issue 2.3.1.5 Does the methodology correctly assess the architecture to provide the mission requirements for capacity		
Criteria: The JCOBIAA assessment methodology identifies all deficiencies/ areas of risk related to capacity		
MOE	2.3.1.5	Effectiveness of the methodology to assess the capability of the architecture design to provide the required information to the required nodes in the required time for the [selected mission area or function]? *Methodology approach: Rating of architecture capacity by link, network, process compared with the mission requirements.*
MOP	2.3.1.5.1	Ratio of predicted to measured communication throughput capacity for the [selected mission area or function].
Data	2.3.1.5.1.1	Predicted communication systems spare capacity for surge capability required by the [selected mission area or function].
Data	2.3.1.5.1.2	Measured communication systems spare capacity for surge capability required by the [selected mission area or function].
Data	2.3.1.5.1.3	Predicted bit error rate (BER)/throughput ratio.
Data	2.3.1.5.1.4	Measured bit error rate (BER)/throughput ratio.
Data	2.3.1.5.1.5	Predicted bandwidth/channel capacity.
Data	2.3.1.5.1.6	Measured bandwidth/channel capacity.
Data	2.3.1.5.1.7	Predicted throughput in various modes of operation (multiplex, asynchronous transfer mode [ATM]).
Data	2.3.1.5.1.8	Measured throughput in various modes of operation (multiplex, asynchronous transfer mode [ATM]).

MOP	2.3.1.5.2	Ratio of predicted to measured processing throughput capabilities of **key systems/processes** to support the [selected mission area or function]
Data	2.3.1.5.2.1	Predicted connectivity/nodal interface capabilities for **key systems/ processes.**
Data	2.3.1.5.2.2	Measured connectivity/nodal interface capabilities for **key systems/ processes.**
Data	2.3.1.5.2.3	Predicted processing speed for **key systems/ processes.**
Data	2.3.1.5.2.4	Measured processing speed for **key systems/ processes.**
Data	2.3.1.5.2.5	Predicted spare capacity for surge or add-on for **key systems/ processes.**
Data	2.3.1.5.2.6	Measured spare capacity for surge or add-on for **key systems/ processes.**
Sub-sub-sub-Issue 2.3.1.6 Does the methodology correctly assess the architecture to provide the mission requirements for interoperability		
Criteria: The JCOBIAA assessment methodology identifies all deficiencies/ areas of risk related to interoperability		
MOE	2.3.1.6	Effectiveness of the methodology to assess the capability of the architecture design to facilitate direct and satisfactory exchange of information or services between and among C4ISR systems and/or pieces of equipment and/or procedures in Joint, Allied/Coalition, interagency and commercial environments? *Methodology approach: Rate systems on technical standards compliance, node and link connectivity and on operational interoperability certification status.*
MOP	2.3.1.6.1	Ratio of predicted to measured **key systems/ processes** that are associated with [selected mission areas or functions] which support technically compliant standards for interoperability.
Data	2.3.1.6.1.1	Predicted number of technically compatible **key systems/ processes.**
Data	2.3.1.6.1.2	Measured number of technically compatible **key systems/ processes.**
MOP	2.3.1.6.2	Ratio of predicted to measured **key systems/ processes** that are interoperable in the operational environment dictated by the [selected mission areas or functions].
Data	2.3.1.6.2.1	Predicted number of operationally certified **key systems/ processes**.
Data	2.3.1.6.2.2	Measured number of interoperable **key systems/ processes**.
Sub-sub-sub-Issue 2.3.1.7 Does the methodology correctly assess the architecture to provide the mission requirements for mobility		

Criteria: The JCOBIAA assessment methodology identifies all deficiencies/ areas of risk related to mobility		
MOE	2.3.1.7	Effectiveness of the methodology to assess the capability of the architecture design's **key systems** to be deployable and operational when needed after arrival. *Methodology approach: Limited assessment. Estimate the impact of the portability/transportability quotient (cube, weight, airlift, sealift, arrival schedule, operational availability) to the mission requirements.*
MOP	2.3.1.7.1	Ratio of predicted to measured Portability/ Transportability of the key JTF C4ISR Architecture components assigned to the JTF AOR.
Data	2.3.1.7.1.1	Predicted mobility values of time and space to deploy and employ **key systems and components**.
Data	2.3.1.7.1.2	User estimated/measured mobility values of time and space to deploy and employ **key systems and components**.
MOP	2.3.1.7.2	Ratio of predicted to user estimated tactical mobility capability
Data	2.3.1.7.2.1	Predicted tactical mobility of **key systems and components** (based on mobile bandwidth capacity, coverage/range capability, physical profile, electrical profile) to meet mission requirements
Data	2.3.1.7.2.2	User estimates of tactical mobility of **key systems and components** (based on mobile bandwidth capacity, coverage/range capability, physical profile, electrical profile) to meet mission requirements.
Sub-sub-sub-Issue 2.3.1.8 Does the methodology correctly assess the architecture to provide the mission requirements for (Reliability, Maintainability, and Availability (RMA))?		
Criteria: The JCOBIAA assessment methodology identifies all deficiencies/ areas of risk related to (Reliability, Maintainability, and Availability (RMA))		
MOE	2.3.1.8	Effectiveness of the methodology to assess the capability of the architecture to possess the required RMA dictated by the [selected mission areas or functions] (Note: The RMA values of actual equipment will not be tested, but rather the predicted impact to missions, i.e. uptime required by mission vs RMA of key systems) *Methodology approach: A risk factor determined by user SMEs will be estimated based on selected RMA values established for assessed systems. Impact will be associated with mission requirements.*
MOP	2.3.1.8.1	Percentage of correctly predicted reliability impacts to selected missions and functions

Data	2.3.1.8.1.1	Predicted impact of reliability values for **key systems** (Mean Time Between Operational Mission Failure (MTBOMF), Mean Time Between Unscheduled Maintenance (MTBUM), etc)**.** .
Data	2.3.1.8.1.2	Measured impact of reliability values for **key systems** (Mean Time Between Operational Mission Failure (MTBOMF), Mean Time Between Unscheduled Maintenance (MTBUM), etc)**.**
MOP	2.3.1.8.2	Percentage of correctly predicted maintainability impacts to selected missions and functions.
Data	2.3.1.8.2.1	Predicted impact of maintainability factors for **key systems** (Mean Operational Mission Failure Repair Time (MOMFRT), Mean Corrective Maintenance Time (MCMT), Maximum Time to Repair (MTTR), Maintenance Man Hours Per Operating Hour (MMH/OH, etc)
Data	2.3.1.8.2.2	Measured impact of maintainability factors for **key systems** (Mean Operational Mission Failure Repair Time (MOMFRT), Mean Corrective Maintenance Time (MCMT), Maximum Time to Repair (MTTR), Maintenance Man Hours Per Operating Hour (MMH/OH, etc)
MOP	2.3.1.8.3	Percentage of correctly predicted availability impacts to selected missions and functions.
Data	2.3.1.8.3.1	Predicted impact of operational availability values of **key systems** on selected mission or functions.
Data	2.3.1.8.3.2	Measured impact of operational availability of **key systems** on selected mission or functions.
Sub-sub-sub-Issue 2.3.1.9 Does the methodology correctly assess the architecture to provide the mission requirements for robustness?		
Criteria: The JCOBIAA assessment methodology identifies all deficiencies/ areas of risk related to robustness		
MOE	2.3.1.9	Effectiveness of the methodology to assess the capability of the architecture design to provide capabilities required by the [selected mission area or function] when degraded conditions are present. Note: the vulnerabilities of the systems will not be tested but rather the predicted impact to the mission. *Methodology approach: limited assessment area. A risk factor will be assigned to systems based on such qualities as proliferation of systems, numbers of spares and contingency plans.*
MOP	2.3.1.9.1	Percentage of correctly predicted impacts on **key systems** and [selected mission area or function] due to environmental requirements.

Data	2.3.1.9.1.1	Predicted impact on **key systems** and [selected mission area or function] during stresses imposed by the physical and operational environment.
Data	2.3.1.9.1.2	Measured impact on **key systems** and [selected mission area or function] during stresses imposed by the (physical and operational environment)
MOP	2.3.1.9.2	Percentage of correctly predicted impacts on **key systems** and [selected mission area or function] due to enemy countermeasure tactics.
Data	2.3.1.9.2.1	Predicted impact on **key systems** and [selected mission area or function] exposed to enemy measures of deception, detection, intrusion, disruption, EMI, etc)
Data	2.3.1.9.2.2	Measured impact on **key systems** and [selected mission area or function] exposed to enemy measures of deception, detection, intrusion, disruption, EMI, etc)
MOP	2.3.1.9.3	Percentage of correctly predicted impacts on **key systems** and [selected mission area or function] due to degraded operations.
Data	2.3.1.9.3.1	Predicted impact on **key systems** and [selected mission area or function] under conditions of degraded operations.
Data	2.3.1.9.3.2	Measured impact on **key systems** and [selected mission area or function] under conditions of degraded operations.
Sub-sub-sub-Issue 2.3.1.10 Does the methodology correctly assess the architecture to provide the mission requirements for security?		
Criteria: The JCOBIAA assessment methodology identifies all deficiencies/ areas of risk related to security		
MOE	2.3.1.10	Effectiveness of the methodology to assess the capability of the architecture design to provide for accessing, processing, and distributing multi-level secure data without unauthorized disclosure or intrusion. *Methodology approach: Risk to security compromise based on physical and procedural controls, encryption parameters, probability of detection/exploitation and mission information exchange requirements*
MOP	2.3.1.10.1	Ratio of predicted to measured proper personnel clearances to requirements dictated by [selected mission area or function] for security access/operations levels.
Data	2.3.1.10.1.1	Prediction of appropriate personnel security levels and special access clearances of assigned personnel by operational facility.
Data	2.3.1.10.1.2	Measurement of personnel security levels and special access clearances of assigned personnel by operational facility.

MOP	2.3.1.10.2	Percentage of correctly predicted impacts on **key systems** and [selected mission area or function] due to verified communications security (COMSEC) vulnerabilities.
Data	2.3.1.10.2.1	Predicted impact of COMSEC vulnerabilities of **key systems** (encryption, intrusion, etc)on [selected mission area or function].
Data	2.3.1.10.2.2	Measured impact of verified COMSEC vulnerabilities of **key systems** on [selected mission area or function].
MOP	2.3.1.10.3	Percentage of correctly predicted impacts on **key systems** and [selected mission area or function] due to verified operational security (OPSEC) vulnerabilities.
Data	2.3.1.10.3.1	Predicted impact of OPSEC vulnerabilities of **key systems** on [selected mission area or function].
Data	2.3.1.10.3.2	Measured impact of verified OPSEC vulnerabilities of **key systems** on [selected mission area or function].
MOP	2.3.1.10.4	Percentage of correctly predicted impacts on **key systems** and [selected mission area or function] due to verified computer security (COMPUSEC) vulnerabilities.
Data	2.3.1.10.4.1	Predicted impact of COMPUSEC vulnerabilities of **key systems** on [selected mission area or function].
Data	2.3.1.10.4.2	Measured impact of COMPUSEC vulnerabilities of **key systems** on [selected mission area or function].
Issue 3.0: How timely, accurately, and completely does the methodology identify solutions to deficiencies in the JTF C4ISR architecture?		
Sub-Issue 3.1 Are solutions to predicted deficiencies submitted in sufficient time to allow implementation by the JTF?		
Criteria: Solutions to deficiencies submitted in time for CJTF to implement		
MOE	3.1	Timeliness of the methodology to identify solutions to deficiencies and implement solution
MOP	3.1.1	Percentage of solutions implemented in time
Data	3.1.1.1	Time to identify a solution to a deficiency
Data	3.1.1.2	Time to implement verified solutions
Data	3.1.1.3	Time JTF needs solution implemented
Sub-Issue 3.2 Do recommended solutions solve deficiencies without corrupting the architecture in another area?		
Sub-sub-Issue 3.2.1 Do implemented solutions correct corresponding deficiencies?		
Criteria: Implemented solutions satisfactorily correct* or mitigate the deficiency or area of risk (*satisfactorily correct rating from CJTF or responsible agent for the deficiency)		
MOE	3.2.1	Correctness of implemented solutions
MOP	3.2.1.1	Percentage of corrected deficiencies
Data	3.2.1.1.1	Number of deficiencies with no solutions identified, by cause (time, technology, budget, policy)
Data	3.2.1.1.2	Number of deficiencies with at least one valid solution

Data	3.2.1.1.3	Number of deficiencies with multiple valid solutions
Sub-sub-Issue 3.2.2 Do implemented solutions that correct corresponding deficiencies cause a deficiency in another area?		
Criteria: Corrections, implemented to deficiencies, do not cause any unacceptable degradation in other areas of the JTF architecture.		
MOE	3.2.2	Improvement Rating of implementing solutions
MOP	3.2.2.1	Ratio of neutral and positive values to negative value added
Data	3.2.2.1.1	Number of implemented solutions with measurable negative value added
Data	3.2.2.1.2	Number of implemented solutions with measurable value added
Data	3.2.2.1.3	Number of implemented solutions with no negative value observable
Sub-Issue 3.3 Are solutions recommended for all deficiencies?		
Criteria: All critical deficiencies have solutions to correct or mitigate risk		
MOE	3.3	Effectiveness of solution recommendation process
MOP	3.3.1	Percentage of deficiencies with recommended solutions
Data	3.3.1.1.1	Number of deficiencies with recommended solutions
Data	3.3.1.1.2	Total number of deficiencies
Issue 4: How suitable is the methodology for the warfighter?		
Sub Issue 4.1 – How useable is the toolset for the trained operational user?		
Sub-Sub-Issue 4.1.1 - Is the collection of data by the assessment team an efficient process to identify and enter that data into the toolset?		
Sub-Sub-Issue 4.1.2 - Is the methodology designed to be adequate for the typical Operator's ability?		
Sub-Sub-Issue 4.1.3 - Can the typical Operator(s) conduct an analysis of the design of a JTF C4ISR architecture?		
Criteria: TBD (note: these three Sub-sub issues will be assessed using the following generic MOE/MOPs, tailored to the area of interest)		
MOE	4.1.3	Useable rating of the Human-Computer Interface (HCI) between the toolset and the operational user?
MOP	4.1.3.1	Percent of experience transfer (likeness/similarity to other applications) for the methodology
MOP	4.1.3.2	Average response times for human-requested actions associated with the methodology to accomplish the assessment
MOP	4.1.3.3	Percent of methodology tools rated easy of use
MOP	4.1.3.4	Percent of tools that can be tailored to meet individual needs/ applications dictated by the JTF particulars
MOP	4.1.3.5	Ratio of automated/manual redundant actions in use of the toolset (reduction in tedium through automation of redundant actions).
MOP	4.1.3.6	Number of appropriate alarms or safeguards to preclude human error in application of the methodology
MOP	4.1.3.7	Ratio of appropriate alerts to critical information/actions in

		the application of the methodology
MOP	4.1.3.8	Percentage of tools with embedded training resources for operator training requirements
MOP	4.1.3.9	Percentage of tools with help functions/contact sensitive help to assist the operator in daily activities
MOP	4.1.3.10	Man hours of training time required to establish an operator pool for the toolset for the methodology
Sub-Issue 4.1.4 - Is the JCOBIAA toolset useable under all anticipated operational conditions?		
Criteria – The JCOBIAA Methodology is useable under operational conditions		
MOE	4.1.4	Usability of the JCOBIAA toolset under operational conditions.
MOP	4.1.4.1	User rating of usability of toolset under operational conditions
Sub-Issue 4.1.5 – Can the team of users produce an assessment of a JTF architecture in the time required?		
Criteria – Team of operational users can successfully accomplish an assessment of the JTF architecture in the required time		
MOP	4.1.5	Time to produce an assessment when conducted by a team of users.
Data	4.1.5.1	Assessment start time
Data	4.1.5.2	Assessment conclusion time
Sub Issue 4.2 – How supportable is the toolset by the intended users?		
Criteria: TBD		
MOP	4.2.1	Ratio of available to required skill levels in the JTF planning cell
MOP	4.2.2	Average annual Man-hours to maintain the JCOBIAA toolset
MOP	4.2.3	Annual estimated costs for the toolset

Table 2.1 Issues, Criteria, and Measures

2.4 PROPOSED JOINT TEST CONCEPT

2.4.1 Overview

The JCOBIAA methodology is a set of tools and procedures to assess integrated architectures. The article under test is the methodology. The resources for the test are Joint Task Force (JTF) C4ISR integrated architectures. As shown in Figure 2.8, the test will be executed with a risk reduction event to mitigate the data requirement; a Mini-Test to refine the test parameters; two test events to assess JTF-level exercises; and an operational event to execute the methodology in an operational environment. The risk reduction event will be conducted in conjunction with a current Joint exercise scenario. The Mini-Test will be conducted in a test facility or laboratory environment. The two test events will be conducted in JTF-level CINC exercises in conjunction with a distributed laboratory environment (See Figure 2.9). The operational event will be an actual rehearsal for a JTF-level operation or a CINC-sponsored exercise.

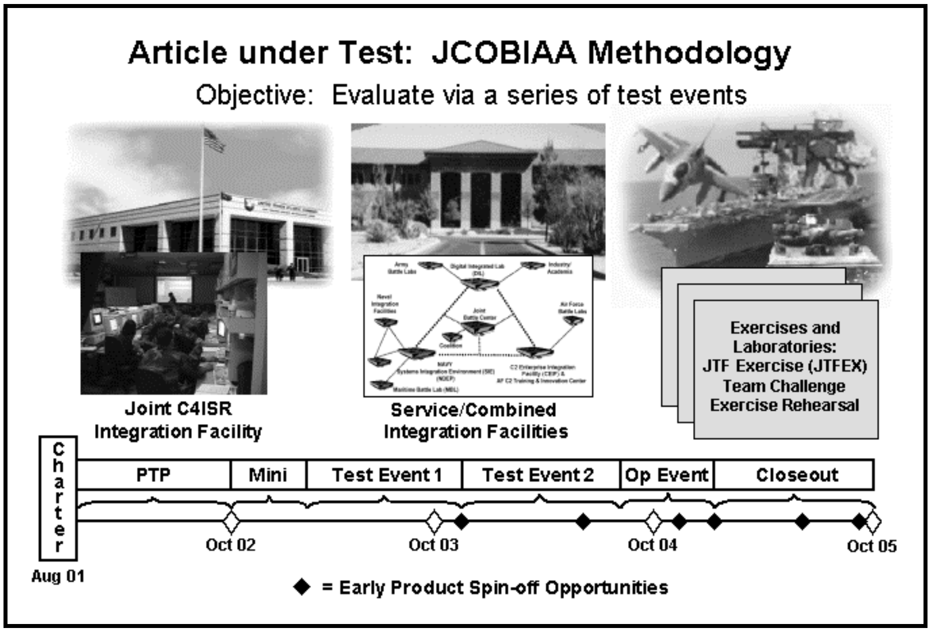


Figure 2.8 JCOBIAA Test Concept

2.4.2 Risk Reduction Event

The risk reduction event is an internal event designed to refine the data mining strategy to capture accurate data required to execute the methodology. The secondary purpose is to refine the behavior and output of the selected tools of the methodology. The risk reduction event will be conducted during the latter stages of the PTP phase, and will use scenarios and architectures developed for and during the Millennium Challenge 02 exercise at USJFCOM.

2.4.3 Mini-Test

The Mini-Test is designed to refine the test parameters and the solution techniques of the methodology. There are seven areas that the Mini-Test will focus on:

- The data mining strategy techniques will be expanded on and improved. Specifically, the techniques are: the use of automated data mining software tools, data sources identification and accessibility, and improvement of techniques for data population of tools.
- A mission-specific JTF C4ISR architecture from the prioritized list of mission areas (TST, TAMD, CSAR, PKO, and SOF) will be used. The architecture will be operated in the laboratory and the results (deficiencies) documented.
- The distributed laboratory environment will be used. Laboratory collaboration and configuration design will be exercised between at least two lab facilities.
- The methodology with its tools and procedures will be conducted. The results will be compared to the laboratory architecture. The results from the Mini-Test will also help refine the methodology.
- Data collection techniques and the type of data collected will be exercised. The techniques will be refined in preparation for the field test events, and the data analyzed to refine the necessary data to collect.
- The Mini-Test event analysis will be conducted with the results provided for use in the first test event.

Figure 2.9 is a flowchart of the events in the Mini-Test:

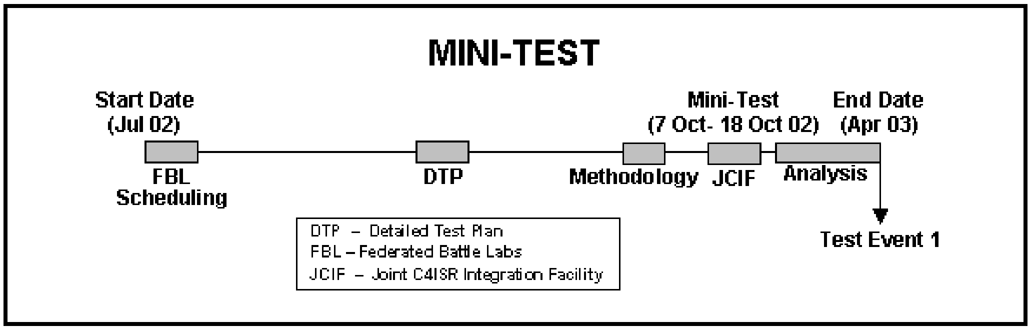


Figure 2.9 JCOBIAA Mini Test

The Joint C4ISR Integration Facility will be used as the primary laboratory to conduct the Mini-Test with other distributed laboratories. The SPAWAR SSC Charleston's Integrated Product Center (IPC) will be used as the second laboratory due to the close relationship to the study as a co-sponsor and risk assessment tool developer. The IPC is a centralized data collection, test, and analysis point. Its configuration provides scaleable support for platform integration and testing, JTF simulation, and full-scale JTF exercises in one location. The back-up laboratory is the Joint Interoperability Test Command (JITC) test facilities. By connecting assets with various Naval, Joint, Allied and non-DOD components, multi-system sensor-to-shooter relationships can be exercised, tested, and evaluated.

2.4.4 Test Event 1

The purpose of the first test event is to validate the assessment methodology using JTF-level exercise architectures based on the selected mission areas. Test Event 1 has six objectives to validate the methodology using a small-scale contingency and minimum complexity.

- The data mining strategy will continue to be exercised and validated. If confident in its ability to capture accurate data, the strategy will become a legacy product and be spun-off for other interested parties.
- The JTF exercise architecture will be assessed by the JCOBIAA methodology. The assessment will be conducted as soon as the architecture has been developed and identified after the venue's Main Planning Conference (MPC).
- Based on the results from the methodology and the exercise scenario, the laboratory test configurations will be identified for those measures not able to be addressed in the exercise. The laboratory test will be conducted in conjunction with the exercise. Coordination with the appropriate laboratories will be required as early as possible.
- A second assessment of the architecture using the JCOBIAA methodology will be conducted after the Final Planning Conference (FPC). The second assessment will address the dynamics of a JTF architecture by assessing any final changes to the architecture. The assessment will also be conducted with personnel independent of the JCOBIAA test team to collect data on the suitability of the methodology.
- The exercise will be conducted with observers documenting architecture deficiencies, any solutions applied, and the outcome of the architecture configuration.
- The results of the exercise and the laboratory testing will be compared to the JCOBIAA methodology results and the analysis conducted.

Figure 2.10 is a flowchart of the events in Test Event 1:

Figure 2.10 JCOBIAA Test Event 1

The USJFCOM Joint Task Force Exercise (JTFEX) is the exercise identified as most appropriate for the first test event. The JTFEX is a CJCS-approved, CINCJFCOM-scheduled, Joint Training Exercise employing Air Force, Navy, Marine Corps, Army, SOF and multinational forces in a littoral environment. It is conducted to support joint interoperability training for USJFCOM forces and is focused on expeditionary operations. The laboratory test in conjunction with the exercise will be conducted using a distributed laboratory environment. The required laboratories will be identified based on scenario, exercise fidelity, and laboratory capabilities.

2.4.5 Test Event 2

The purpose of the second test event is to validate the JCOBIAA methodology using a more complex JTF-level architectures mission priority list. The increased complexity includes: greater service and coalition involvement and a larger mission focus. Test Event 2 has six objectives to validate the methodology using a regional conflict scenario and greater complexity.

- Continue refining the data mining strategy expanding the data source retrieval and tool population automation.
- The JTF exercise architecture will be assessed by the JCOBIAA methodology. The assessment will be conducted as soon as the architecture has been developed and identified after the venue's MPC. The assessment will include both identifying deficiencies in the architecture and developing potential solutions.
- Based on the results from the methodology and the exercise scenario, the laboratory test configurations will be identified for those measures not able to be addressed in the exercise. The laboratory test will be conducted in conjunction with the exercise. Coordination with the appropriate laboratories will be required as early as possible.
- A second assessment of the architecture using the JCOBIAA methodology will be conducted after the Final Planning Conference (FPC). The second assessment will address the dynamics of a JTF architecture by assessing any final changes to the architecture. The assessment will also be conducted with personnel independent of the JCOBIAA test team to collect data on the suitability of the methodology.
- The exercise will be conducted with observers documenting architecture deficiencies, any solutions applied, and the outcome of the architecture configuration.
- The results of the exercise and the laboratory testing will be compared to the JCOBIAA methodology results and the analysis conducted.

Figure 2.11 is a flowchart of the events in Test Event 2.

Figure 2.11 JCOBIAA Test Event 2

The US Pacific Command (USPACOM) Team Challenge is the exercise identified as most appropriate for the second test event. The Team Challenge is a CJCS-approved, USPACOM-scheduled, joint/combined exercise designed to train a USCINCPAC contingency Joint Task Force and improve interoperability within the US Armed Services and with the Armed Forces of Thailand, Singapore, Philippines, and Australia. It draws bilateral exercises into a regional exercise framework. The laboratory test in conjunction with the exercise will be conducted using a distributed laboratory environment. The required laboratories will be identified based on scenario, exercise fidelity, and laboratory capabilities.

2.4.6 Operational Event

The purpose of the last major event is to conduct an operational test of the JCOBIAA methodology using JTF-level architectures in a Joint Communications Support Element (JCSE)-supported operation rehearsal or CINC-level exercise. The operational event has four goals in testing the methodology.

- The operational event architecture will be assessed by the JCOBIAA methodology. The assessment will be conducted by the JCSE team as soon as the architecture has been developed and identified. The assessment will include both identifying deficiencies in the architecture and developing potential solutions.
- The methodology results will be provided to the JFC or exercise director for potential implementation.
- Laboratory test configurations will be identified to conduct the methodology End-to-End testing. Coordination with the appropriate laboratories will be required as early as possible.
- The rehearsal or exercise will be conducted and lessons learned documented on the suitability and effectiveness of the methodology for incorporating into the final report.

Figure 2.12 is a flowchart of the events in the Operational Event:

Figure 2.12 JCOBIAA Operational Event

The JCSE-supported operational event will be identified based on the timeframe of the event and input from the JCSE. A laboratory test in conjunction with the exercise will be conducted using a distributed laboratory environment. The required laboratories will be identified based on JCOBIAA methodology results.

2.4.7 Summary

The JCOBIAA test concept incorporates the “crawl, walk, run” concept by using a risk reduction event and Mini-Test to prepare for the actual tests; conducting two tests to validate the methodology; and participating in an operational event to execute the performance of the JCOBIAA methodology. Each event builds on the previous event and ensures minimal risk at each stage of the test.

2.5 PROPOSED JOINT TEST SCOPE

2.5.1 Overview

A challenging aspect of the JCOBIAA JFS was narrowing the scope of an expansive problem to a size that was executable without losing relevancy to a DoD community that is more reliant on C4ISR architectures and Network-Centric Warfare every day.

Because of the size and complexity of Joint C4ISR architectures, the JCOBIAA JFS team has necessarily limited the scope of the JT&E to specific organizational levels, focused aspects of the assessment process, and specific solution areas in the C4ISR architecture. The process to arrive at the final scope was based on the testability issues that were brought out through the issue decomposition, the mission scenario development, and the C4ISR architecture assessment process. Foremost in the scope considerations were the priorities of the warfighters.

2.5.2 Organizational Level

Joint C4ISR architectures cover a wide range of organizations and levels. The JCOBIAA JT&E will focus on the Joint C4ISR architecture assessment processes at and below the JTF level with primary emphasis on the JTF Operational level and Joint Component level. Key reach-back requirements will be additionally addressed as identified by scenario. The JCOBIAA JT&E will be conducted in operationally realistic environments during CINC-led joint exercises that include JTF functional elements to assess the effectiveness and efficiency of the JCOBIAA methodology.

2.5.3 Assessment Area

Due to the size and complexity of Joint C4ISR architectures and the current capabilities of C4ISR architecture assessment tools, the JCOBIAA JT&E will focus on operational and systems interoperability of a JTF architecture. Technical architecture features will be selectively considered. To further scope interoperability, the top C4ISR interoperability issues were selected as the focus for the JTF architecture assessment. Table 2.2 lists the top focus areas for the JT&E, based on the CINC's top C4ISR priority list. Although, the JCOBIAA methodology will focus on these selected interoperability issues, the JT&E will show that the methodology is universally applicable to other interoperability issues. The missions selected for assessment contain these interoperability issues. The missions are discussed in Section 2.6 and are all C4ISR intensive.

An additional concern is how detailed the assessment is in the selected mission area. While the toolset offers a variety of detailed assessments (e.g. down to emulations of data packet protocol comparison), the scope of the test may be further limited by the time available to accomplish the assessment. This will result in applying the envisioned broad architecture assessment strategy with selected detailed assessments conducted using the appropriate tools.

TOP C4ISR INTEROPERABILITY ISSUES
Interoperability and security risk of systems
Mission Timelines (e.g. Time Critical Targeting, CSAR, SOF Insertion)
Operational and Tactical Data Links
Operational Information Exchange (e.g. Command & Control, Collection)
Voice Links
Intelligence System Interoperability
Combat Identification (e.g. Target Identification and Acquisition)
Coalition Warfare Interoperability

Table 2.2 Top C4ISR Interoperability Issues

2.5.4 Solution Focus

The JCOBIAA JT&E will focus on near-term JCOBIAA methodology enhancements, defined as improved data mining techniques, improved assessment tool processes, and refined Joint C4ISR architectures. Commercial off-the-shelf (COTS) and Government off-the-shelf (GOTS) architecture assessment tools and joint interoperability enhancements are specifically within the scope. Applying such tools to identify solutions to C4ISR architecture deficiencies should provide improvements in categories similar to enhancing sensor-to-shooter information links to meet mission requirements and improving intelligence architectures for data management (or collection).

2.5.5 Mission Areas

For Joint military operations, Joint C4ISR architectures support a variety of different missions of the JTF. The JCOBIAA methodology will focus on selected mission areas that are universally applicable across any CINC mission area. Section 2.6 addresses the specifics on the selection process of the mission areas for the JCOBIAA JT&E.

2.6 PROPOSED JOINT TEST SCENARIO

2.6.1 Overview

The test scenarios chosen for the JCOBIAA JT&E program are designed to ensure that high priority core warfighting capabilities and the full spectrum of warfare are considered and addressed during the test. Since the JT&E cannot cover all possible scenarios, it must consider the different levels of conflict and the warfighter priorities. The concept of the methodology is that the assessment can be applied to any Joint C4ISR architecture supporting the warfighting mission no matter how large and complex or how small and simplistic. The choice of scenarios needs to be representative of the CINC priorities and the relevant missions of a JTF operation.

2.6.2 Test Scenario Criteria

Criteria were established to determine which scenarios would be best suited for the test of the JCOBIAA methodology. This is not meant to limit the capabilities of the methodology, but to ensure the full capabilities of the tools are flexed. The following four criteria were assessed in regards to JTF missions and C4ISR architectures.

- **CINC/Warfighter Priorities.** An Operational Advisory Group (OAG) was established to ensure that warfighter priorities are voiced and considered in the development of the test scenarios and test opportunities. Representatives from each Service provided input to mission priorities. Also considered were the inputs from the CINCs and Services during the numerous briefings of the feasibility study to the warfighter. The OAG will continue meeting at least once a year during the test with representatives from the CINCs and Services to continue to ensure the test meets its objectives in terms of operational relevance.
- **C4ISR Intensity.** How intensive the C4ISR requirements are in a given mission is important to the test methodology. As the JT&E progresses through each stage, it increases in realism. It is important that each scenario has a certain level of C4ISR robustness for an opportunity to appropriately assess the JTF C4ISR architecture.
- **Information Availability.** It is important in selecting mission areas that there is enough data available (e.g. doctrine, JTTP, C2 and force requirements, etc.) on the JTF architecture to perform a realistic assessment.
- **Jointness.** Finally, how much Service component involvement is required to conduct the mission? The mission areas needed for the JT&E are those that require two or more Service components to conduct the mission. This will help ensure diverse and complex mission threads in the JTF exercise architecture of the JT&E.

Having assessed the criteria for selecting mission areas for the JT&E, Figure 2.13 shows a summary of the warfighter mission areas nominated through the OAG, other Joint and Service-specific high priority mission lists, and CINC/Service feasibility study input. The mission areas were rated using the four selection criteria and the top five mission areas were selected. The JCOBIAA test will address some, but not all, of these missions and their sub-missions in the methodology assessment and the JTF exercise test venues.

Mission Area	CINC/ Warfighter Priority	C4ISR Intensity	Information Availability	"Jointness"
Combat Search & Rescue (CSAR)	●	●	●	●
Time Sensitive Targeting (TST)	●	●	●	●
Peacekeeping Operations (PKO)	●	●	◐	●
Theater Air & Missile Defense (TAMD)	●	●	◐	●
SOF Insertion Operations (SOF)	●	●	◐	◐
Close Air Support (CAS)	●	●	◐	●
Drug Interdiction Operations	◐	●	◐	◐
Maritime Interdiction Operations (MIO)	◐	◐	◐	○

● = High ◐ = Medium ○ = Low

Figure 2.13 Mission Area Selection

2.6.4 Summary

Selecting the appropriate mission areas for the JCOBIAA JT&E is an important part of the feasibility study. The appropriate selection of the scenarios brings relevance and credibility to the test results. Understanding military operations at all levels, establishing selection criteria, and considering warfighter priorities all contribute to the selection of the most viable and beneficial missions to test the JCOBIAA methodology.

2.7 TEST METHODS

The JCOBIAA JT&E will incorporate a diverse but conventional group of data collection methods. There are, however, distinct phases to each test event. The first JCOBIAA JT&E data collection phase begins with the measurement of collecting C4ISR architecture data, based on the organizations that form the JTF. The test venue JTF architecture data elements are then used to populate the JCOBIAA Toolset. The next phase for measurement is the JCOBIAA methodology and output (deficiency/solution). Finally, the last collection phase is the test event where evidence is collected on the presence (or absence) of predicted/unpredicted deficiencies and the results of solutions implemented to validate the methodology. The JT&E test events outlined in Section 2.4 will mirror these collection phases with varying degrees of emphasis. Data collection methods vary with each issue to be addressed in each phase as shown in Figure 2.14.

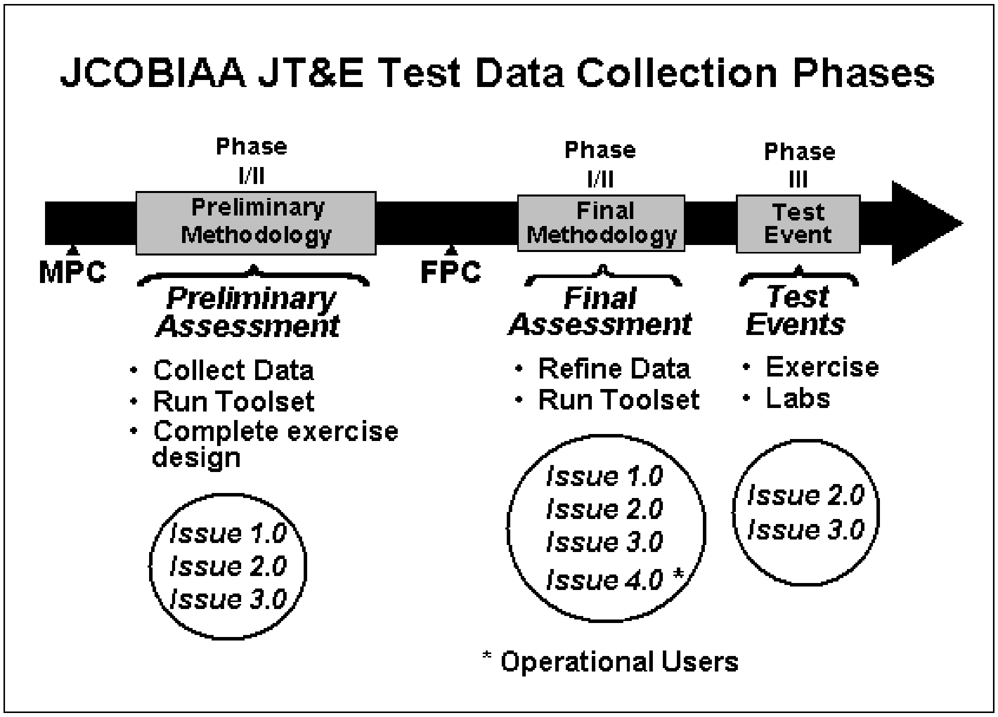


Figure 2.14 Test Data Collection Phases

2.7.1 Phase One – Data Population (Data for JCOBIAA Toolset and Procedures)

The first phase of each test event will begin when the test architecture is sufficiently defined (resources, objectives, missions, location identified). For the two test events, this will occur at the conclusion of the Main Planning Conference (MPC). In the case of the Mini-Test, the data collection and toolset population represent an investigation of best practice and approach to collect data on a small-scale, with phase one commencing at the direction of the test director. For the operational event, phase one begins when the event's JTF planning commences and the architecture is identified.

Phase One addresses data to answer Issue 1.0 (How timely, accurately, and completely the analytical toolset is populated with required C4ISR architecture information?). Issue 4.0 (How suitable the methodology is for use by the warfighter?) is also measured during Phase One as well as Phase Two. However, the use of operationally representative users will occur in the final assessment using the methodology after the Final Planning Conference (FPC) prior to the start of the exercise. While the data collected on deficiencies and solutions using the methodology (Issues 2.0 and 3.0) will not be validated at this stage, it will help guide the test instrumentation methods employed for the exercise events.

To populate the toolset, three main sources and their processes will be measured for timeliness, accuracy, completeness and user interface. These sources are illustrated in Figure 2.15 and are comprised of:

- The JTF tasking information (exercise design architecture- see Appendix D)
- The JCOBIAA Toolset Library
- The Data Mining Strategy implementation (see Appendix D and F).

Time to accomplish toolset population and quality measures of the populated data will be derived from operator time elapsed logs, database retrieval records/files, and operator/process owner questionnaires (note: process owners are those individuals: SME's, JTF Staff, exercise planners, etc. who are required to provide unique process and activity data such as the time to accomplish a CSAR intelligence update task.).

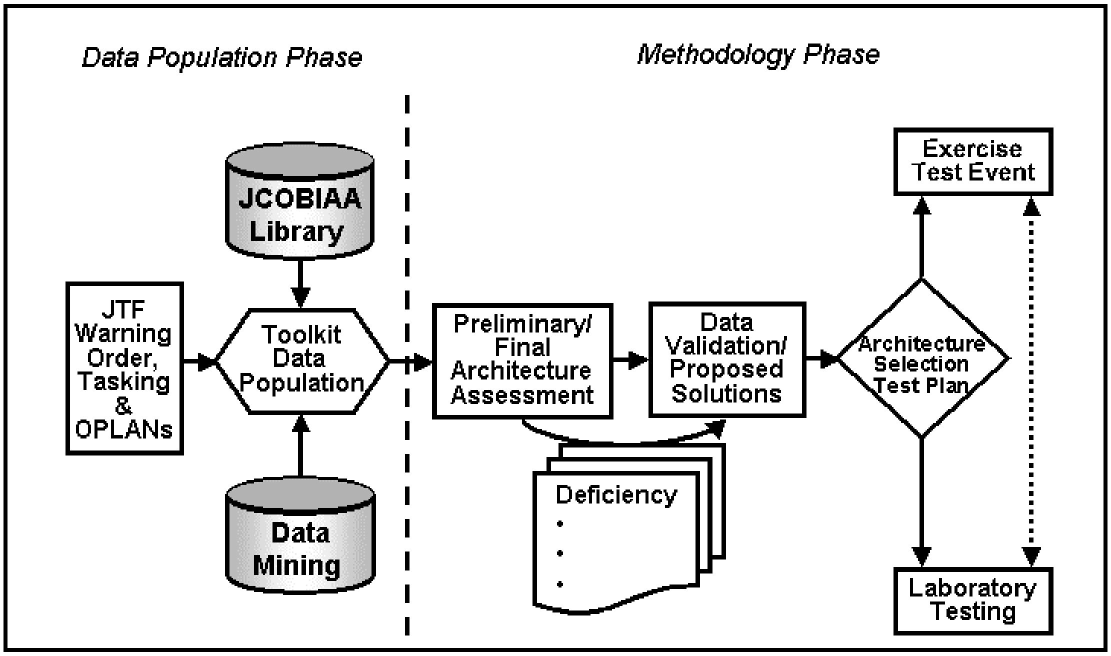


Figure 2.15 Data Collection and Assessment

2.7.2 Phase Two – Methodology (Architecture Assessment Process)

Phase Two addresses Issue 2.0 (How timely, accurately, and completely the methodology identifies deficiencies in the JTF C4ISR architecture?) and 3.0 (How timely, accurately, and completely the methodology identifies solutions to predicted deficiencies in the JTF C4ISR architecture?), but the accuracy and completeness measures are not validated until the test events are conducted**.**

Since the JCOBIAA toolset is a composite tool with graduated levels of fidelity, time to accomplish the assessment of the target architecture will be partitioned to each tool accordingly, as well as aggregated for the total assessment. Deficiencies noted will also be logged and characterized. Operator logs, run files, assessment records and operator questionnaires will be maintained during the methodology run. The broad assessment tools are populated with limited, but key, detail about the architecture. For example:

Suitability data for Issue 4.0 will be of interest, and several data collection and assessment run events will occur using operational users to elicit their comments through surveys and by direct observation by the test team data collectors. The focus of these typical user trials will occur after the FPC when tied to an exercise.

Since some of the solutions to correct potential deficiencies are expected to be intuitive to the typical operational user, solutions may be proposed directly with the deficiency. Other solutions may have to be deferred for proper verification (or discovery, if not known) through test sequences in the exercise or in a lab configuration.

2.7.3 Phase Three – Exercise/Lab (Test Execution)

The conduct of Test Events 1 and 2 will each be composites of major exercise sites and a complement of lab locations. Lab selection examples are illustrated in Section 5.0. While it is not envisioned that the laboratory activity will be time-synced with the exercise event schedule on a day-to-day basis, there is an expected input mechanism whereby solutions verified outside the exercise can be considered during a later phase in the test to verify that improvements has been achieved. Some distributed lab connectivity is expected based on the configurations under test and the capabilities of the labs selected.

The majority of instrumentation of the test site will be planned through the Detailed Test Plan, based on an efficient and coordinated effort with the exercise planners. Since particular deficiencies and solutions may not be known at this stage, the instrumentation plan will be focused on broad coverage of the test network to collect measures of performance that apply to the Sub Issues 2.3. Such measures as the following will be collected from the exercise architecture:

1. Link Data Rates
2. Utilization rate
3. Resistance to EMI
4. Link Propagation delay
5. End-to-end connectivity
6. Data loss events
7. Integrity and clarity of information
8. Throughput

Collection will be via standard network and router status/performance monitors. Data will be specifically grouped by key C4ISR systems, nodes and networks based on the scenario requirements. Other data collection methods using data collection types listed in Figure 2.16 will be planned to provide minimum intrusion and detraction from exercise/mission activities. The assessment output will be used to focus data collection if not already pre-planned. The JCOBIAA JT&E team will review the assessment output to aid further assignment of architecture configurations to the test venues of lab testing, exercise site, or a combination of both. This phase will involve the entire complement of test methods envisioned for this test as discussed in Section 3.0 and will verify the toolset assessment.

The JCOBIAA JT&E Team will have a test network established that is separate from the main exercise to support white cell VTCs, JCOBIAA JT&E participant pre-briefs, debriefs, test status monitoring and data consolidation.

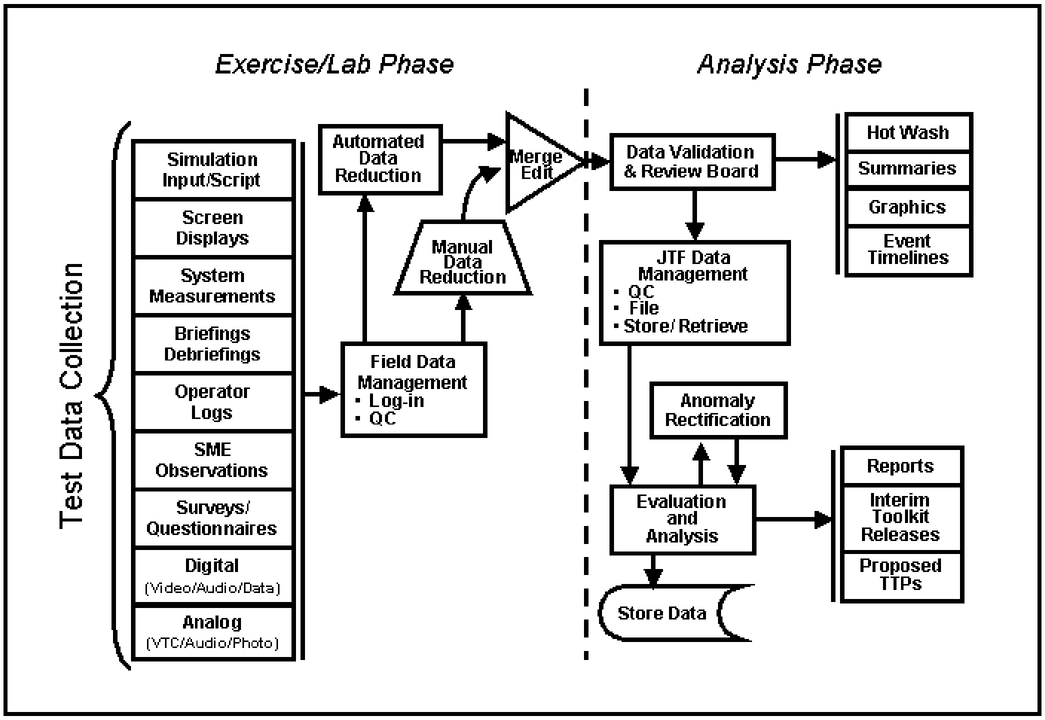


Figure 2.16 Test Event and Post-Test Analysis

2.7.4 Phase Four – Test Analysis

The analysis phase will begin upon conclusion of Phase One and Two, since test measures are being addressed there. The bulk of the verification data required to support the methodology assessment will be collected in Phase Three and are illustrated in the next section in Table 2.3. A comprehensive Configuration Management (CM) plan will control and secure the analysis data, particularly since some elements span all phases of each test event and are linked across a fairly long timeline. During the test, data will be collected at the appropriate site of the deficiency. If a deficiency is more qualitative, user surveys will be completed, as appropriate, to indicate the impact the deficiency had on operations. If the deficiency is beyond the scope of the exercise configuration, lab testing may be substituted through validated lab configurations. The final analysis will compare the predicted deficiencies with the observed results to verify and validate the methodology and its associated tools as an appropriate and valuable asset to the JFC and his staff. The data collection for Issues 1.0, 2.0, and 3.0 is expected to afford opportunities to expand test trials to encompass excursions into other architecture configurations. The only limited data set will be the opportunity to measure operational users actually using the toolset (Phase One/Two at the Final Assessment) and the number of validating events executed during the exercises. Mitigating strategies will be investigated such as using laboratory configurations (validated, verified and accredited (VVA) for the test purpose) to expand methodology validating events.

2.8 TEST CELL MATRIX

Table 2.3 shows where issues, sub-issues, and measures are addressed over the different planned events. The "**X**" indicates a data collection opportunity. The "**X***" is an expected observation point for the Operational Test Event. Data collected here will be an addendum section to the final test report. The Sub Issues and Measures are simplified for readability but are expanded in Section 2.3, Issue and Measures. This test cell matrix will greatly aid in the development of the PTP.

X= Data Collection "V"= Data Collected to validate Method, X*= Data Collected/Observed in Op Event			**Mini-Test**	**Test Event 1**			**Test Event 2**			**Op Event**
2.8.1 Issues, Sub-Issues, Measures				Conduct Asse'nt	Exercise	Labs	Conduct Asse'nt	Exercise	Labs	
Issue	1.0	Data Population	X	X			X			X*
Sub-Issue	1.1	Identify data	X	X			X			X*
MOE	1.1	Measure	X	X			X			X*
Sub-Issue	1.2	Collect data	X	X			X			X*
MOE	1.1.1	Measure	X	X			X			X*
Sub-Issue	1.3	Interoperability of	X	X			X			X*
MOE	1.3	Measure	X	X			X			X*
Sub-Issue	1.4	Time to collect	X	X			X			X*
MOE	1.4.1	Measure	X	X			X			X*
MOE	1.4.2	Measure	X	X			X			X*
Sub-Issue	1.5	Correctness of data	X	X			X			X*
MOE	1.5	Measure	X	X			X			X*
Sub-Issue	1.6	Completeness of	X	X			X			X*
MOE	1.6	Measure	X	X			X			X*
Issue	2.0	Identify Deficiencies	X	X			X			X*
Sub-Issue	2.1	Time to identify	X	X			X			X*
MOE	2.1.1	Measure	X	X			X			X*
MOE	2.1.2	Measure	X	X			X			X*
Sub-Issue	2.2	Accuracy of	X	X	V	V	X	V	V	X*
MOE	2.2.1	Measure	X	X	V	V	X	V	V	X*
MOE	2.2.2	Measure	X	X	V	V	X	V	V	X*
Sub-Issue	2.3	Completeness of	X	X	V	V	X	V	V	X*
Sub-sub-	2.3.1	Completeness	X	X	V	V	X	V	V	X*
MOE	2.3.1.1	Accessibility	X	X	V	V	X	V	V	X*
MOE	2.3.1.2	Accuracy	X	X	V	V	X	V	V	X*
MOE	2.3.1.3	Adaptability	X	X	V	V	X	V	V	X*
MOE	2.3.1.4	Completeness	X	X	V	V	X	V	V	X*
MOE	2.3.1.5	Capacity	X	X	V	V	X	V	V	X*
MOE	2.3.1.6	Interoperability	X	X	V	V	X	V	V	X*
MOE	2.3.1.7	Mobility	X	X	V	V	X	V	V	X*
MOE	2.3.1.8	RMA	X	X	V	V	X	V	V	X*
MOE	2.3.1.9	Robust	X	X	V	V	X	V	V	X*

X= Data Collection "V"= Data Collected to validate Method, X*= Data Collected/Observed in Op Event			**Mini-Test**	**Test Event 1**			**Test Event 2**			**Op Event**
2.8.1 Issues, Sub-Issues, Measures				Conduct Asse'nt	Exercise	Labs	Conduct Asse'nt	Exercise	Labs	
MOE	2.3.1.1	Security	X	X	V	V	X	V	V	X*
Issue	3.0	Identify Solutions	X	X			X			X*
Sub-Issue	3.1	Time to identify	X	X			X			X*
MOE	3.1	Measure	X	X			X			X*
Sub-Issue	3.2	Accuracy of	X	X	V	V	X	V	V	X*
MOE	3.2.1	Measure	X	X	V	V	X	V	V	X*
MOE	3.2.2	Measure	X	X	V	V	X	V	V	X*
Sub-Issue	3.3	Completeness of	X	X	V	V	X	V	V	X*
MOE	3.3	Measure	X	X	V	V	X	V	V	X*
Issue	4.0	Suitability	X	X			X			X*
Sub Issue	4.1	Useable	X	X			X			X*
MOE	4.1.1	Measure	X	X			X			X*
Sub Issue	4.2	Supportable	X	X			X			X*
MOP	4.2.1	Measure	X	X			X			X*
MOP	4.2.2	Measure	X	X			X			X*
MOP	4.2.3	Measure	X	X			X			X*

Table 2.3 Test Cell Matrix

2.9 TEST OPPORTUNITIES

2.9.1 Overview

Cost, OPTEMPO, and availability of Joint assets (forces, C4ISR systems, etc.) will dictate that JCOBIAA JT&E be conducted during a suitable, existing test, or training event.

2.9.2 Test Opportunity Criteria

In determining the optimal test venues for the JCOBIAA test, six test opportunity criteria were established. The following six criteria are discussed below to assist in determining the choice of venues.

- **Mission Areas.** The venue needs to exercise the selected high-priority mission areas (e.g. Time Sensitive Targeting) with a representative Joint C4ISR architecture. Section 2.6 addresses the top five missions selected to be tested.
- **Availability.** The venue needs a consistent history for being conducted on schedule. The venue must fit the timeline of the JT&E schedule.
- **Jointness.** The level of involvement by each of the four Services in the exercise venues is a key to the selection of the venue. The more robust the "jointness" of the exercise, the more credible the test is to the CINCs and Services. All four Services must participate in the venue with their representative C4ISR architectures designed to meet the JTF mission requirements.
- **Operational Realism.** The venue must consist of a realistic test environment, both in exercising the mission and in the operating environment. Representative live forces and the force structure are important to the credibility of the test. An operationally relevant exercise is a key priority.
- **Control.** Training versus test requirements must be weighed to ensure that data based on realistic operational realism can be collected. The exercise must provide sufficient opportunity to collect data required by the JT&E with a minimum impact on the training goals of the exercise director.
- **Cost.** The location and the test resource requirements of the venue must be weighed in regards to cost versus realism. The venue environment must be operationally relevant, but consideration will be made to the distance to travel by the JCOBIAA test team to the exercise. Also, the capabilities of the venue to support a test with equipment and logistics support should be considered, as well.

Figure 2.19 shows the venue opportunities, the selected mission areas for the test with associated venues, and the values of each criterion for each venue in determining the optimum test venues.

Venue	Mission Areas: CSAR	PKO	TST	TAMD	SOF	Availability	Jointness	Operational Realism	Control	Cost
* JTFEX 03-3	X	X	X	X	X	●	●	●	◐	●
* Team Challenge 04	X	X	X	X	X	●	●	●	◐	◐
◆Unified Endeavor 03-2	X		X	X		●	●	◐	◐	●
◆Olympic Challenge 04	X		X	X		●	●	◐	◐	◐
◆Tempo Brave 04	X	X		X	X	●	◐	◐	◐	◐
Ulchi Focus Lens 04	X		X	X	X	◐	●	◐	○	○
Agile Response 05		X		X	X	◐	◐	◐	◐	◐
Roving Sands 03			X			◐	◐	●	◐	◐
JCIET 04				X		◐	●	○	●	●
Determined Promise 04						◐	●	○	◐	●

● = Good (Top 1/3) ◐ = Fair (Middle 1/3) ○ = Poor (Bottom 1/3)

* = Primary Venues ◆ = Back-up Venues

Figure 2.17 JCOBIAA Test Opportunity Matrix

2.9.3 Test Event Venue Requirements

Each JCOBIAA test event has objectives defined in Section 2.4, Test Concept. The test events are described below in relation to a suitable test venue. The tentative venue choices are identified.

2.9.3.1 Risk Reduction Event

The risk reduction event is an internal substantiation of the data retrieval strategy and a refinement of the methodology conducted during the PTP phase. The USJFCOM Millennium Challenge 02 provides the scenario and architecture development, the data requirements, and the timeframe necessary to conduct the risk reduction event.

2.9.3.2 Mini-Test

The Mini-Test is a test to refine the methodology solution techniques, test procedures using a distributed laboratory environment. The venue should be:

- A distributed laboratory event, preferably with at least one program sponsor laboratory.
- Support JTF-level systems and components.
- Provides greater level of complexity for mission string analysis.

The laboratories selected in supporting the Mini-Test are the JCIF in conjunction with the SPAWAR SSC Charleston IPC. As co-sponsors to the test, SPAWAR and USJFCOM test facilities are ideal for a JCOBIAA test and for linking into a distributed environment. An alternate choice is to use the Joint Interoperability Test Command (JITC) Joint Interoperability Test Facilities due to program mentorship and as the DoD-designated joint interoperability lead test agency.

2.9.3.3 Test Event 1

Test Event 1 is to validate the JCOBIAA assessment methodology by conducting the methodology and comparing the results to the exercise C4ISR architecture performance. Test Event 1 will also validate the data mining strategy through the conduct of the methodology. Being the first test event, the venue will be:

- In the continental U.S., preferably on the East Coast (close proximity to the JCOBIAA JT&E site).
- USJFCOM-sponsored exercise due to sponsorship and exercise coordination.
- A maritime-focused joint operation due to Navy and SPAWAR sponsorship.
- A scenario exercising the selected priority mission areas.

The venue selected is the USJFCOM Joint Task Force Exercise (JTFEX) 03-3 which provides the timeframe, environment, and mission areas needed for Test Event 1. The alternate choice is the Unified Endeavor 03-2 due to USJFCOM-sponsorship and location. The associated distributed laboratory test event will be identified based on exercise and mission selection.

2.9.3.4 Test Event 2

Test Event 2 is to validate the JCOBIAA assessment methodology by conducting the methodology and comparing the results to the exercise C4ISR architecture performance. Test Event 2 will also validate improvements on solution recommendations. The second test event venue should be:

- An operationally relevant exercise in a realistic environment.
- CINC-led exercise due to warfighter relevance and credibility.
- A joint operation with a greater ground focus to ensure coverage of the full spectrum of warfare.
- A scenario exercising the selected priority mission areas.

The venue selected is the USPACOM Team Challenge 04, which provides an exercise that encompasses simultaneous JTF missions that covers the timeframe, complexity and mission areas needed for Test Event 2. The alternate choice is to use Olympic Challenge 04 due to USJFCOM-sponsorship and the complexity of the joint force operation. The associated distributed laboratory test event will be identified based on exercise and mission selection.

2.9.3.5 Operational Event

The Operational Event is to validate the JCOBIAA assessment methodology by conducting the methodology using the USJFCOM assessment team and implementing the results in an actual operational rehearsal or realistic CINC-led exercise. The venue should be:

- An actual JTF operational rehearsal environment or CINC-led exercise supported by the JCSE.

A JCSE-supported operation or exercise will be identified within the timeframe necessary for the Operational Event that will include the realism and environment to fit the requirements of the event. Alternate choices are to use USPACOM Tempo Brave 04 or USEUCOM Agile Response 05, which fit the timeframe, complexity, and mission areas necessary to execute the methodology. The End-to-End testing in association with the assessment methodology will be identified based on the assessment results.

2.9.4 Letters Of Agreement

The JCOBIAA Test Director will have Letters of Agreement (LOA) with the owners of the selected venues agreeing to plan for JCOBIAA JT&E participation in the venue. This schedule will be refined during the PTP development and the LOAs will be revised as Memorandum of Agreements (MOAs). These MOAs will be revalidated and refined during detailed planning for each test. Detailed test planning will be synchronized with the 12-month test and exercise planning cycles used by the venue owners. Venue decisions will be finalized no later than one year prior to execution. This decision point is compatible with decision times for current exercise planning cycles.

2.9.5 Summary

Figure 2-18 shows the JCOBIAA test venues and backup venues based on the venue screening process outlined above and agreements with the venue sponsors. Each test event builds on the previous event and grows in complexity and realism. The Mini-Test will only test within a laboratory environment, whereas the test events use both the test events and the distributed laboratory environment to conduct the test. The operational event is the test of the operational use of the methodology using the USJFCOM assessment team and validation of the methodology using an operational rehearsal.

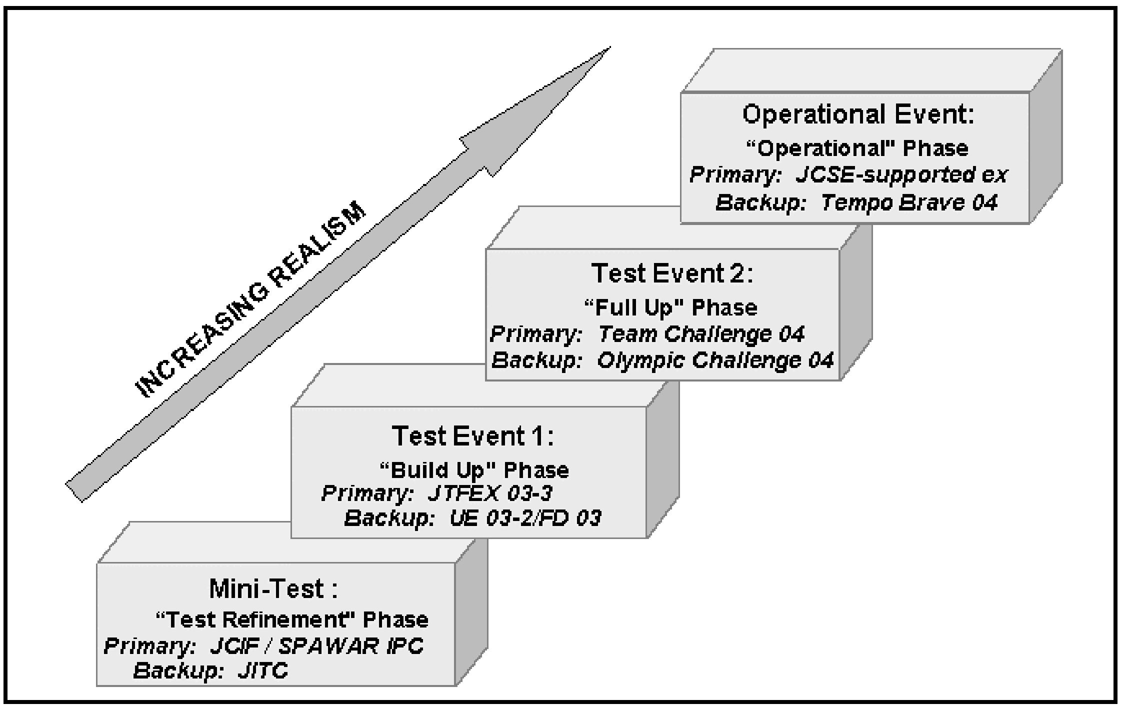


Figure 2.18 JCOBIAA Test Venue Selections

2.10 TEST SCHEDULE

2.10.1 Overview

The JCOBIAA JT&E schedule is divided into six phases, each of which builds on the previous phase. The six phases are:

- Program Test Plan (including risk reduction event)
- Mini-Test
- Test Event 1
- Test Event 2
- Operational Event
- Program Closedown

The JCOBIAA test schedule summary is shown in Figure 2.19. The details of each test phase are described in the following sections.

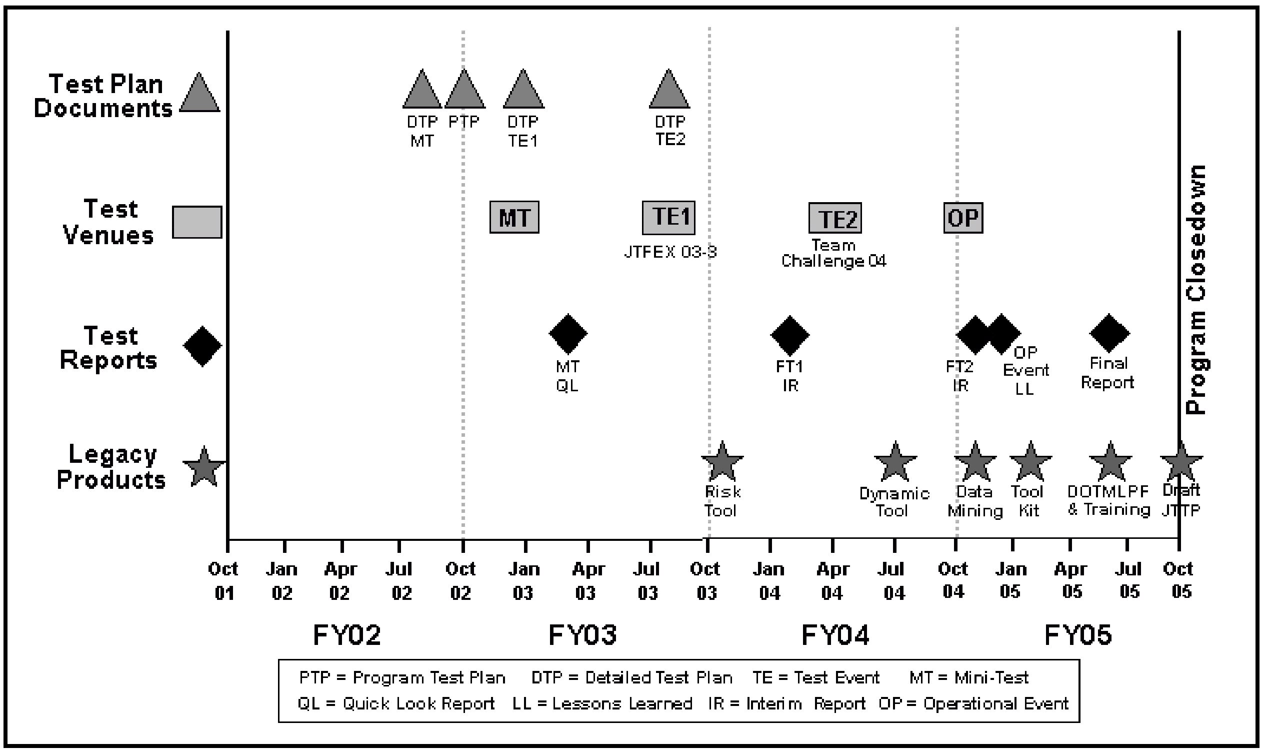


Figure 2.19 JCOBIAA Test Schedule Summary

2.10.2 Program Test Plan

The Program Test Plan (PTP) is scheduled for the first year of the JT&E commencing October 2001. During the first year of writing the PTP, laboratory test scheduling, and writing of the Detailed Test Plan (DTP) for the Mini-Test, based on the PTP, will also be accomplished. This is to ensure the Mini-Test will be accomplished within six months of the PTP being approved. The PTP will be completed and signed for approval by DD,DT&E no later than 15 September 2002 per JT&E Policy Letter 98-06.

2.10.3 Mini-Test

The Mini-Test Planning Phase commences during the PTP phase and includes the scheduling of the distributed laboratories. The DTP will be completed by 1 August 2002. The Mini-Test will commence the methodology assessment upon approval of the PTP by DD, DT&E and DOT&E and the identification of the test architecture. The Mini-Test distributed laboratory event will be conducted at the JCIF and the SPAWAR SSC Charleston Integrated Product Center. Upon completion of the data analysis, a Mini-Test report will be provided in preparation for conducting Test Event 1. Figure 2.20 is a summary flow chart of the JCOBIAA Mini-Test schedule.

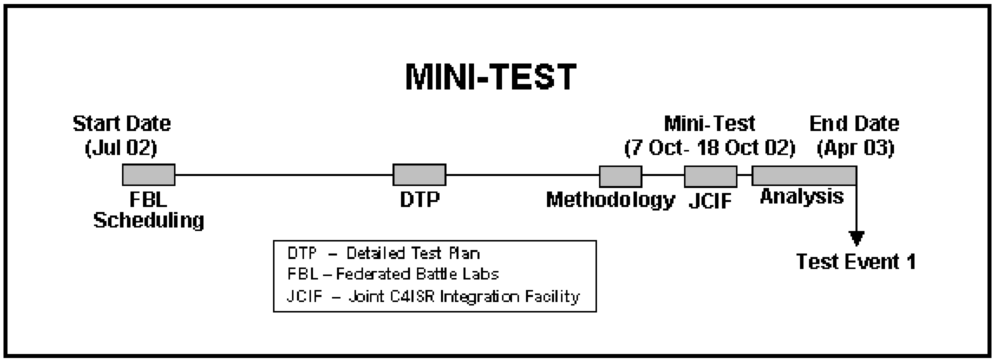


Figure 2.20 JCOBIAA Mini-Test Schedule

2.10.4 Test Event 1

During the Test Event 1 Planning Phase, scheduling of required laboratory facilities will be coordinated and conducted. Additionally, the test requirements will be discussed at the exercise Concept Development Conference (CDC). Following approval of the DTP, JCOBIAA will participate in all exercise planning conferences. Following the exercise Main Planning Conference (MPC), the exercise architecture will be identified and the JCOBIAA methodology assessment conducted. After completion of the assessment, the distributed laboratory configuration will be determined. Following the Final Planning Conference (FPC), a second methodology assessment will be conducted to address any final changes to the architecture and collect data on the suitability of the architecture. The exercise event will be the USJFCOM Joint Task Force Exercise (JTFEX) 03-3 conducted from 11 August to 01 September 2003. The distributed laboratory test will be conducted in conjunction with the exercise event. Following the test event, the six-month analysis phase will commence. Upon completion of the analysis phase, an interim report will be provided as a progress report on the validation of the methodology and in preparation for conducting Test Event 2. Figure 2.21 is a summary flow chart of the JCOBIAA Test Event 1 schedule.

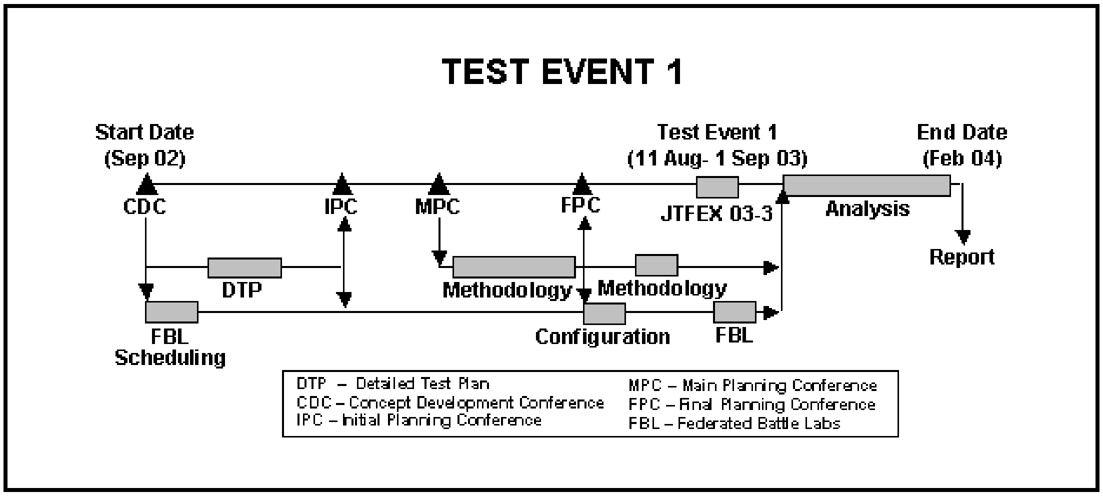


Figure 2.21 JCOBIAA Test Event 1 Schedule

2.10.5 Test Event 2

During the Test Event 2 Planning Phase, scheduling of required laboratory facilities will be coordinated and conducted. Additionally, the test requirements will be discussed at the exercise CDC. Following approval of the DTP, JCOBIAA will participate in all exercise planning conferences. Following the exercise Main Planning Conference (MPC), the exercise architecture will be identified and the JCOBIAA methodology assessment conducted. After completion of the assessment, the distributed laboratory configuration will be determined. Following the Final Planning Conference (FPC), a second methodology assessment will be conducted to address any final changes to the architecture and collect data on the suitability of the architecture. The exercise event will be the USPACOM Team Challenge 04 conducted in May 2004. The distributed laboratory test will be conducted in conjunction with the exercise event. Following the test event, the six-month analysis phase will commence. Upon completion of the analysis phase, an interim report will be provided as a progress report on the validation of the methodology and in preparation for conducting the Operational Event. Figure 2.22 is a summary flow chart of the JCOBIAA Test Event 2 schedule.

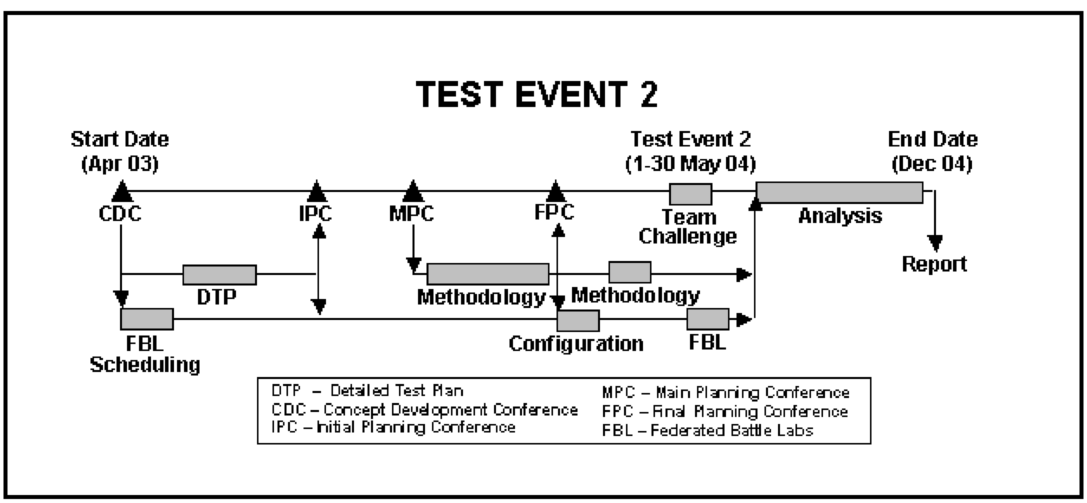


Figure 2.22 JCOBIAA Test Event 2 Schedule

2.10.6 Operational Event

The test begins upon the commencement of the JTF Joint Planning Phase of the JTF operational rehearsal or exercise. Upon identification of the JTF Joint C4ISR architecture, USJFCOM personnel will execute the JCOBIAA methodology. After completion of the assessment, the distributed laboratory configuration will be determined, and the laboratory End-to-End assessment will be conducted. The operational event will be a JCSE-supported operational rehearsal conducted in the October 2004 timeframe. If there is no operation during the timeframe, then either the USPACOM exercise Tempo Brave 04 or USEUCOM exercise Agile Response 05 will be used. Following the operational event, an interim report and Lessons Learned will be provided and incorporated into the final report during the Closedown Phase. Figure 2.23 is a summary flow chart of the JCOBIAA Operational Event schedule.

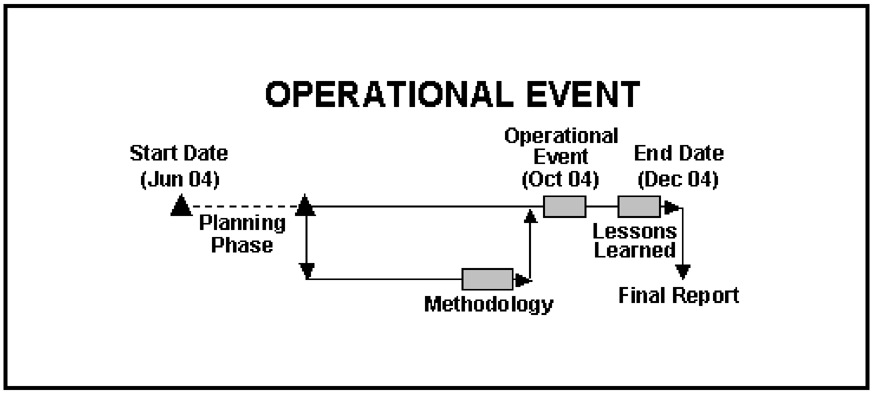


Figure 2.23 JCOBIAA Operational Event Schedule

2.10.7 Program Closedown

Preparatory closedown work will begin in October 2004 with the Test Event 2 Interim Report and the Operational Test Interim Report and Lessons Learned included in December 2004. The final report will be submitted in June 2005. Following the submission of the final report, briefings are required to program sponsors, CINCs, Services, and other interested agencies on the test results. The Program Closedown will be completed in October 2005.

2.10.8 Summary

The detailed JCOBIAA test schedule identifies the timeline, overlap between phases and the concept of one phase building on the next. Figures 2.24 shows the overall detailed test schedule.

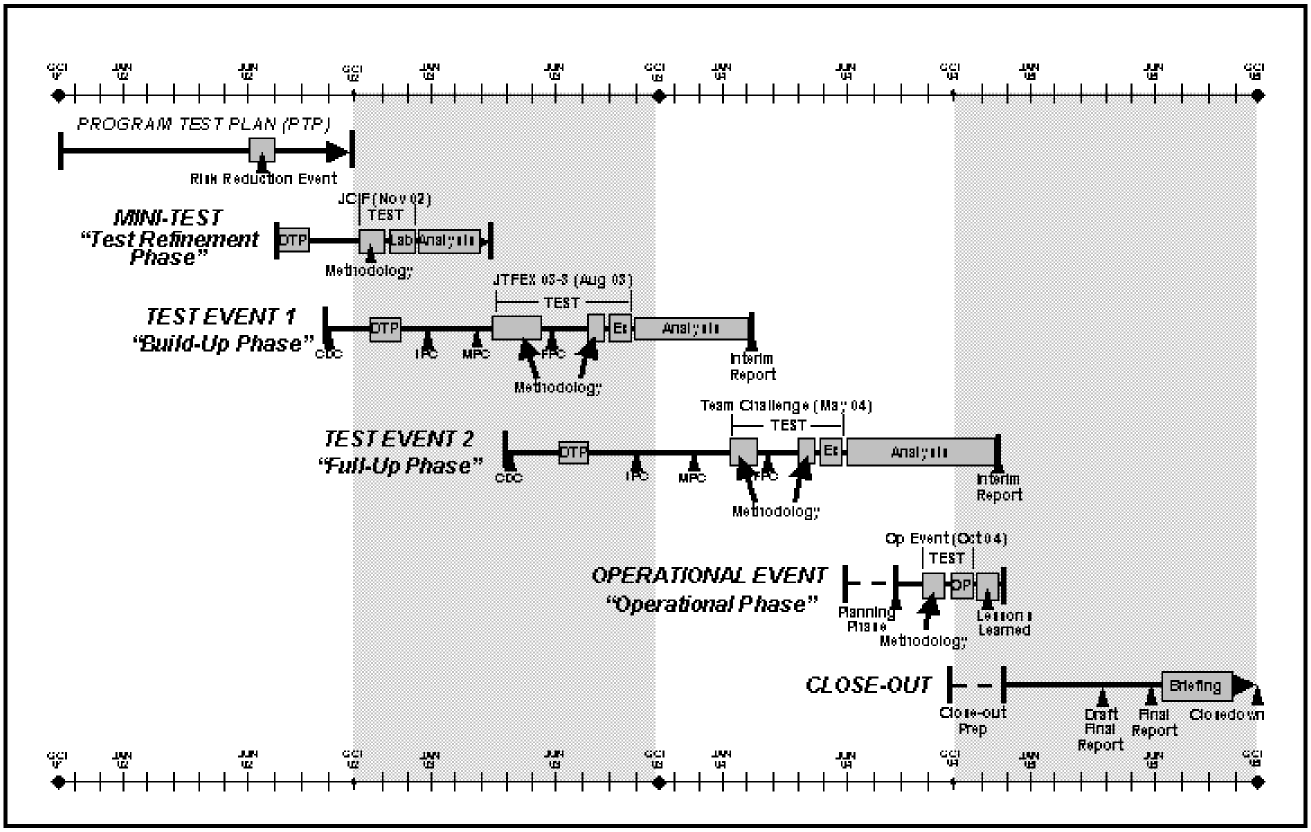


Figure 2.24 Detailed Test Schedule

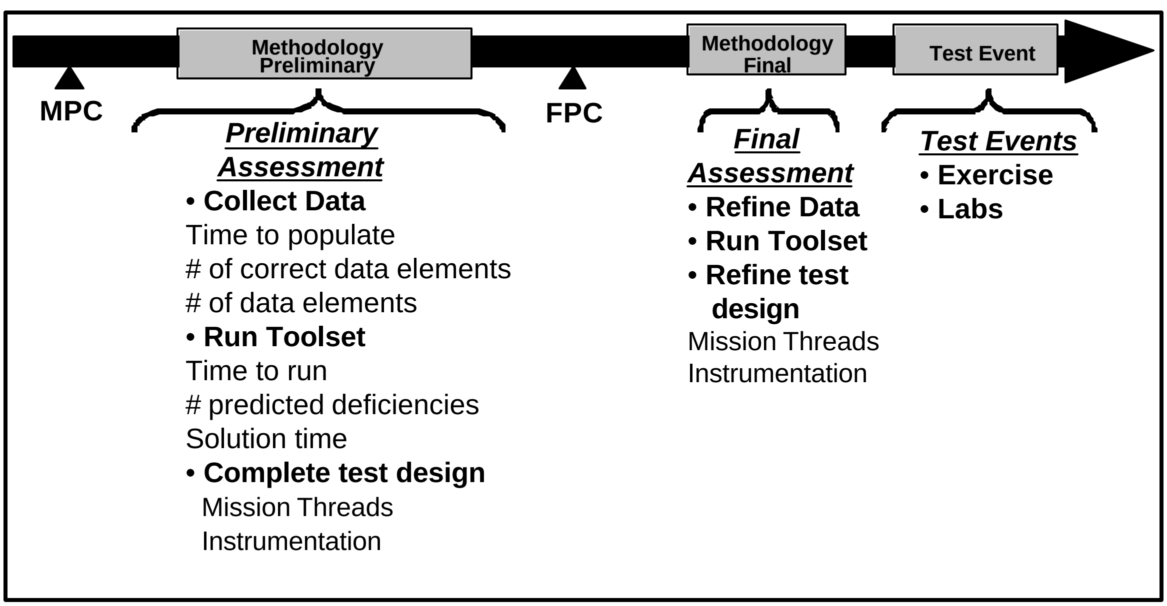
3.0 DATA MANAGEMENT AND ANALYSIS

3.1 Data Management Methodology

3.1.1 Data Mining/Assessment Data Management

Information to populate the toolset and conduct an architecture assessment will begin with the JTF tasking order and subsequent JTF staff and intelligence planning sessions outlined in Joint Doctrine. While this beginning data outline is crucial to understanding the tasking for the JTF, additional ancillary detailed data will need to be "harvested" from authoritative locations as outlined in Appendix D. In exercises, there is unlikely to be a realistic pre-exercise JTF planning session, therefore, data outlining the JTF tasking and situation will be acquired from the exercise planners. The data base mining tools are listed and discussed in Appendix F. Data files will be under configuration management. Key test measures associated with data mining are the time needed to identify and access the source as well as the correctness and completeness of the data. A complete data set will be used during the preliminary assessment (see Figure 3.1). This will allow the actual exercise instrumentation package to be planned. During the final assessment, a separate "clean" run will be performed again under a more realistic pressure of time using operational users to assess the test measures of usability and the Human Computer Interface qualities. If this second assessment reveals additional areas of concern, efforts will be made to incorporate them into additional lab testing.

Figure 3.1 Test Data Collection Points



When the assessment tools are run, the data from the assessment output will be treated as test data. Input records, output files and results will all be under configuration control and management.

3.1.2 Data Management of Test Events

Data collection conducted during the exercises will involve a combination of collection formats based on the C4ISR deficiency or solution profile. This data collection plan will be designed to validate that the deficiency exists or that the solution actually corrected the problem without creating problems elsewhere in the architecture.

- **Simulation/Stimulation (Sim/Stim) Input Files and Scripts**. Since realistic communications and sensor loading as well as operator reactions and stimulation may often have to occur as a result of scripted inputs, these will be logged and archived.
- **Screen Display**. Screen displays can be critical to measuring operator information opportunities and reactions as well as verifying certain display attributes. Methods to capture can be white cell repeater stations, observer recording (if unobtrusive), and video monitoring.
- **System Measurements**. If systems are sufficiently representative of the actual configuration at issue, either network probes/monitors or record files can be employed. The network monitors will record such things as traffic activity and backlog, the output record files can capture message sent/ received logs, operator input record, etc.
- **Briefings/Debriefings**. These occur in a test for both test planners (white force meetings) and the test/exercise operator's briefing and debriefing. Records of briefing materials as well as video transcripts of VTC or individual operator site briefs are of value.
- **Operator Logs**. Operator logs will be reviewed and kept after event runs. Every effort will be made to ensure that the process mirrors the real world practice so as not to introduce any invalid operator task distractions unless the test scenario requires the activity.
- **Subject Matter Expert (SME) Observations**. Forms for SME observations will be designed ahead of time if used. Input method will emphasis the "record once - at the source" approach where possible using electronic input media.
- **Surveys/Questionnaires**. Many of the data collection efforts are the comments and recommendations of operators and test event participants. Surveys can be used to measure the level of knowledge prior to conduct of operations. On test event conclusion, they can capture qualitative data about decisions and alternatives exercised as well as offer other measures as the exercise/test progresses. Every effort must be made to eliminate bias and ambiguous questions. The surveys must also be made as convenient as possible to accomplish, realizing that many exercises span 12-hour duty cycles and fatigue is a factor. Also important to remember is that the return rate to questionnaires is historically low if not accomplished immediately after the event period.
- **Digital Video, Audio, Data Files**. File records will be kept in two main forms where possible. Prior to the exercise, every attempt will be made to identify exactly what data point; attribute fields and format requirements are required. If this data is recorded electronically, it will be written to file as a data reduction step. The second main form will be to capture a complete data file of all pertinent data sources. Time stamping and other marking methods are imperative to allow data location and extraction later. Data continuity will be examined, particularly in cases of track file initiation and transfer to avoid loss of track continuity.
- **Analogue Video, VTC, Photo, Audio, Data Logs**. Analogue capture files will be accomplished where prudent, realizing the data processing requirements to manually view, sort, verify, catalogue, index and store.

The following chart, Figure 3.2, diagrams all of the various steps data takes once it is collected from a test event. Starting in the left upper corner, data will be collected from the various methods listed. At each day's conclusion, a data quality manager will collect form, tapes, and questionnaires from data collectors and review for completeness. Manual and automated data will be reduced and merged into the appropriate data bin(s). Data will go through a formal review and archive. A daily output for quick look reporting (hot wash) and a report to test control to assess whether the day's events are successful or need to be rescheduled.

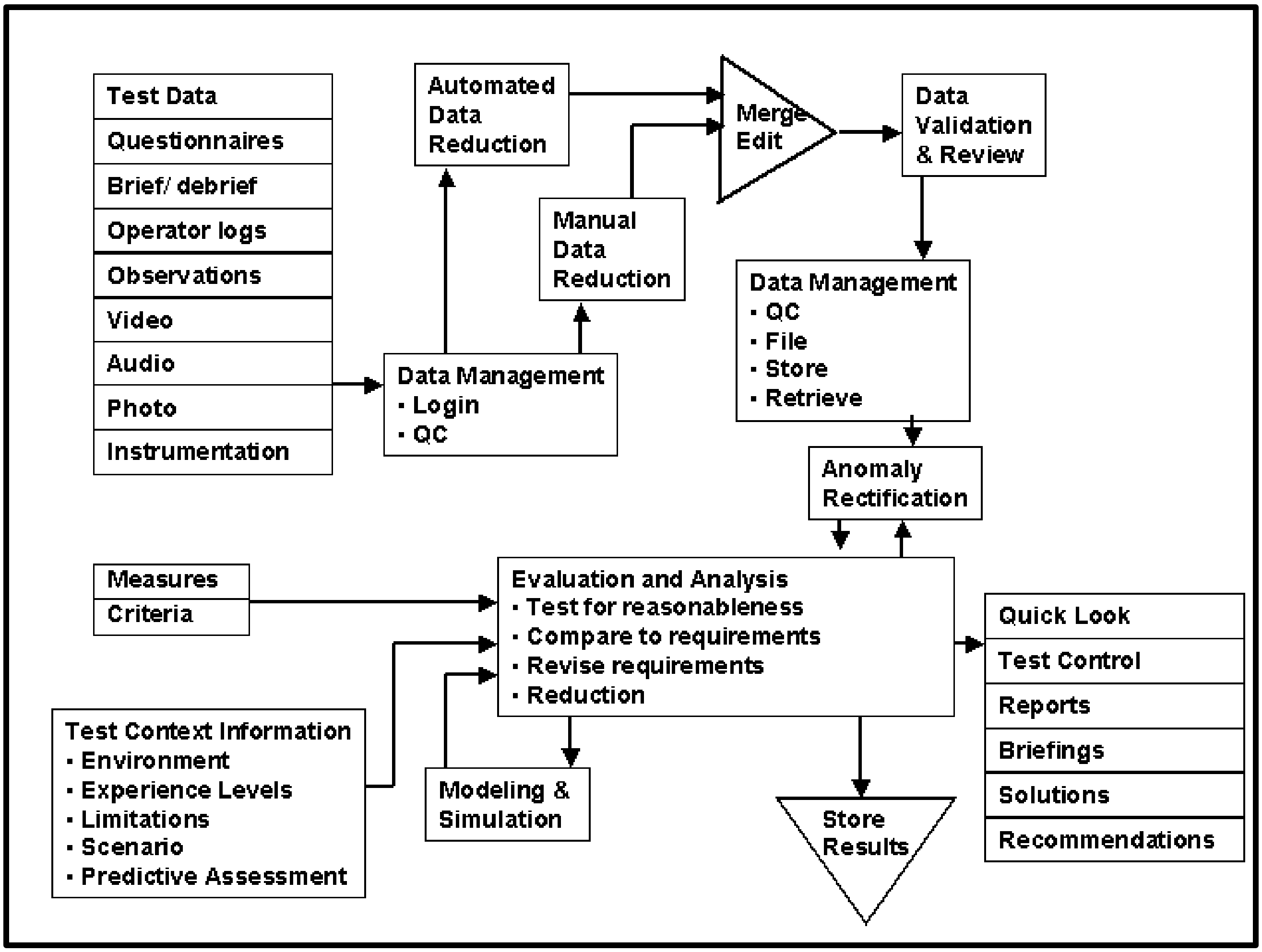


Figure 3.2 Data Management and Analysis Flow Process

3.2 ANALYSIS METHODOLOGY

3.2.1 Toolkit Analysis

Analysis of the various selected tools to address areas of the C4ISR architecture will occur during Phases One (data population) and Two (assessment runs). Verification of the deficiency predictions will occur after comparison and confirmation through the actual test events (Phase Three). Deficiencies are expected to appear in the context of a testable measure such as those listed in Section 2.3, Issues and Measures. While some tools provide varied degrees of specificity based on the input data, it is expected that the test events will allow an exercise configuration to verify deficiencies/solutions and to measure the impact. Typical deficiencies will be associated with an architecture and mission tasks that are in the exercise scenario:

Deficiencies in mission requirements for **Accessibility** - information needed by the selected mission area or function not received in time or at the requested location.

- Equipment incompatibilities
- Frequency incompatibilities
- LOS exceeded

Deficiencies in mission requirements for **Accuracy** - information provided for this selected mission area or function is correct. Correct information is that information that reflects the actual situation (ground truth).

- Target movement rates exceed shooter acquisition parameters
- Data links congested – time delays
- Systems with information (i.e. target tracks) cannot correlate across the network

Deficiencies in mission requirements for **Adaptability** - adapt to changes in technology and to intelligently adjust to compensate for shortfall in capability.

- Legacy protocols
- Inability to perform in degraded modes

Deficiencies in mission requirements for **Completeness** - tasks required by the selected mission area or function that the system is able to support successfully.

- System failure under load increases

Deficiencies in mission requirements for **Capacity** -providing the required information to the required nodes in the required time for the selected mission area or function.

- Measured capacity cannot support estimated requirements
- Surge capacity

Deficiencies in mission requirements for **Interoperability** - the capability to facilitate direct and satisfactory exchange of information or services between and among C4ISR systems and/or pieces of equipment and/or procedures in Joint, Allied/Coalition, interagency and commercial environments.

- System designed (before assessment) to provide information rated interoperable

Deficiencies in mission requirements for **Mobility** - impact of the portability/transportability characteristics on the mission requirements.

- Estimated impact of scheme of movement to be supported by assigned equipment.

Deficiencies in mission requirements for **Reliability, Maintainability**, and **Availability** - possessing the required RMA dictated by the selected mission areas or functions.

- Failure of a system to provide the required availability
- System reliability short of mission requirements
- System maintainability prevents mission execution

Deficiencies in mission requirements for **Robustness –** ability to provide capabilities required by the selected mission area or function when degraded conditions are present.

- Systems not rated as robust

Deficiencies in mission requirements for **Security** - the capability of providing for accessing, processing, and distributing multi-level secure data without unauthorized disclosure or intrusion.

- Encryption parameters
- Probability of detection
- EMI
- Probability of exploitation

Each of the tools will be assessed on their ability to predict deficiencies in these major areas important to a C4ISR architecture.

3.2.2 Analysis of the Data Population Scheme

This assessment will be conducted when the assessment has been concluded and will be based on operational planners and user surveys as well as time records to identify the data for the initial JTF tasking event. The quality of the data will also be assessed through a sampling of the data acquired and a review to confirm its accuracy and update cycle.

3.2.3 Test Event Data Capture

While the Data Management and Analysis Flow Example in Figure 3.2 shows the collection of test data types, the following illustration (Figure 3.3) shows a more graphic depiction of a test event involving various collection opportunities to their locations and in configurations that have been noted by the JCOBIAA methodology as either deficient or potentially so.

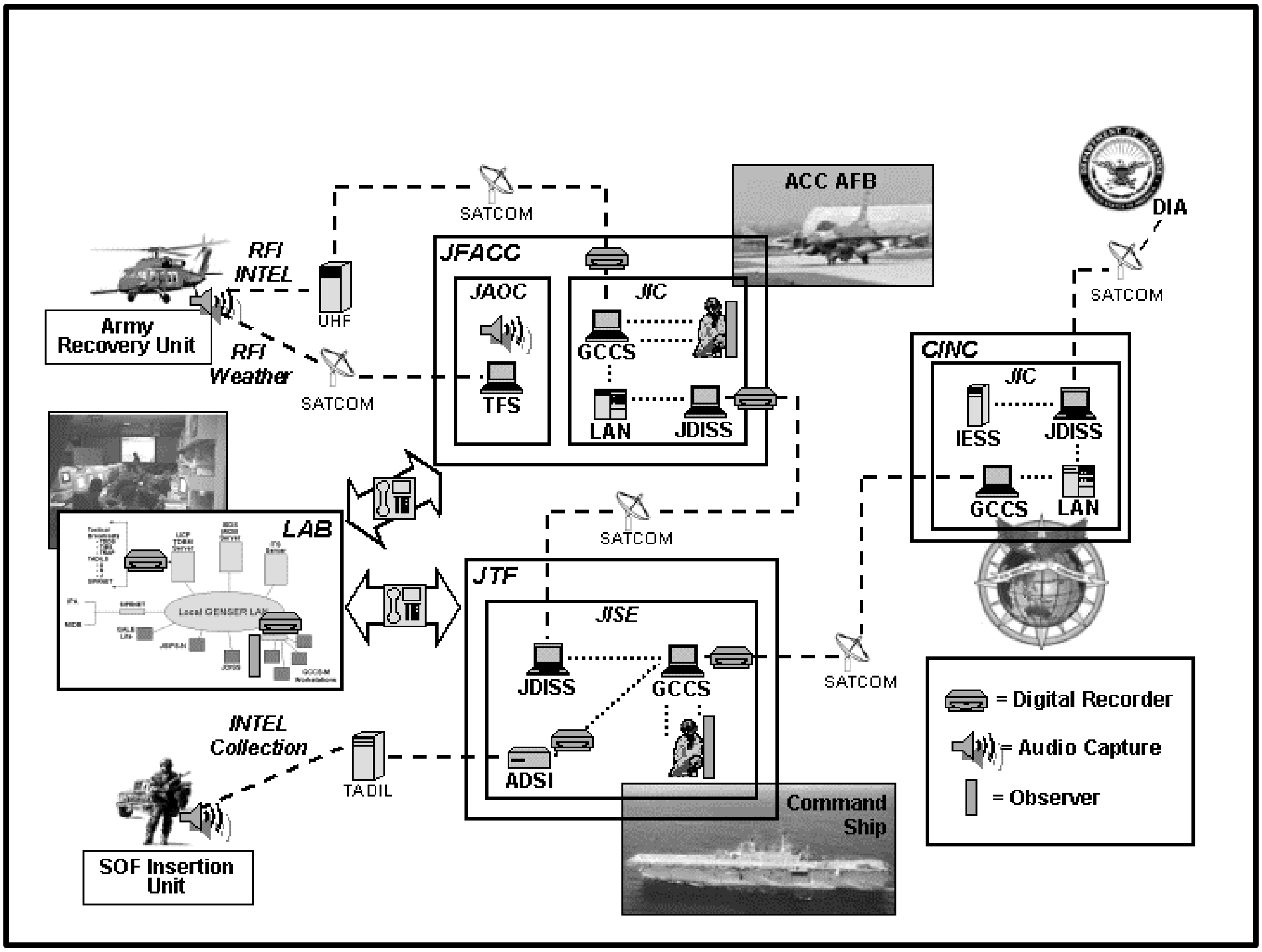


Figure 3.3 Hypothetical Test Example

In the test example, if a request for information takes too long according to the mission requirements as assessed by the JCOBIAA methodology, the measurement methods would be to capture the request message of interest and the response message of interest and record the time sent and received. Observers would be located at the sites where human process created a delay. The mission sequence would be observed for anomalies and the impact of the unchanged architecture would be documented through operator survey. This approach helps document the validity and impact of the deficiency. Similar sequences would be prepared for other deficiencies or solutions.

4.0 JT LEGACY PRODUCTS

4.1 DESCRIPTION

4.1.1 Overview

Experience of past JT&Es shows that early identification of its customer and legacy product requirements are critical to a successful Joint Test. The customer should be involved in the JT&E test planning and execution to ensure the product will be institutionalized once the test is completed. The JCOBIAA team continues to formalize the customer and legacy product requirements. The primary customers will be represented on the JCOBIAA Operational Advisory Group (OAG) to ensure input to product development during the test and feedback as products are released. Legacy products are based on the findings, conclusions, and evaluation of JT&E data and issue resolution. These will result in recommendations to the JTF C4ISR planning process, and implementation of the JCOBIAA methodology and tools to support pre-employment JTF C4ISR planning.

The JCOBIAA JT&E will assess a series of JTF C4ISR architectures to determine deficiencies and recommended solutions. Resulting test and evaluation findings, conclusions, recommendations, and legacy products will provide the means for the JTF to conduct C4ISR architecture assessments prior to JTF operations. As the JT&E test events are concluded, the JCOBIAA test team will develop, document, and disseminate conclusions regarding the JCOBIAA methodology and its processes. The resulting spectrum of JCOBIAA legacy products depicted in Figure 4.1 will serve to implement and institutionalize JT&E conclusions and recommendations. Each product is described in detail below.

Products	Users
• Assessment Methodology • Methodology Testing Reports • Data Mining Strategy • Assessment Team (provided by USJFCOM) • Training Documentation • Draft JTTP • DOTMLPF Input	• CJTFs/JFCs • CINCs • Service Staffs • Joint Staff • Doctrine Commands • Service Tactical Development Groups • Architecture Developers • DoD-wide Community
★ Legacy Product Owner - USJFCOM	

Figure 4.1 JCOBIAA Test Product Overview

4.1.2 Assessment Methodology

The JCOBIAA JT&E will test a Joint C4ISR assessment methodology to assess JTF C4ISR integrated architectures. The methodology is a set of tools and procedures to rapidly assist the JTF Commander and components to assess the interoperability and reliability of the Joint C4ISR architecture prior to a JTF operation. As a result of the JT&E, a toolset handbook will be developed that defines the requirements and procedures of Joint C4ISR architecture assessment methodology including the use of the tools necessary to conduct an assessment and enhance JTF planning. If a particular tool in the toolset is validated early in the test and could provide immediate value to the JTF, then a tool handbook would be developed and released prior to the end of the test to assist the CINC's and Services in its use. The goal is to have an integrated risk assessment tool available as early as November 2003. The second goal is to have a system dynamic analysis tool available as early as July 2004. Finally, a prototype toolset handbook is planned to be available by February 2005. The users of the methodology results will be primarily the JTF staff and component staffs, however, combatant CINC staffs, the Service staffs, Joint Staff, USJFCOM, and other training organizations, and the acquisition community will also benefit.

4.1.3 Methodology Testing Reports

Throughout the JT&E, periodic validated results will be provided to the user community to continue the support and involvement during the test. The following test results will be provided:

- **Interim reports.** Interim reports will be provided at the end of each test event to update findings on the efficiency and utility of the JCOBIAA methodology for potential use in real-world JTF operations.
- **Lessons Learned report.** Lessons Learned will be provided at the end of the operational event to update findings on the efficiency and utility of the JCOBIAA methodology and as a measure of its success using an assessment team provided by the USJFCOM Joint Communications Support Element (JCSE) personnel in an actual JTF operational rehearsal or joint exercise.
- **Spin-off products.** As test events are completed, if the data strategy or a particular assessment tool is considered mature enough to stand on its own and of value to the user immediately, the tool will be released to the user with the necessary handbook on the use and training. The concept is to deliver products to the warfighter as soon as possible.
- **Final report.** The final report will include the analysis from the two test events and the operational event. It will provide the necessary validation and recommendations to utilize the methodology and institutionalize the process.

The JCOBIAA team will coordinate with the USJFCOM and Joint Staff to apply relevant test results, lessons learned, and recommendations to Joint and multi-Service publications. Other tangible products from JCOBIAA will include: briefings to the users, a newsletter, a web site, brochures, information booths at T&E conferences and symposiums, technical papers, videos, and interactive multimedia CD-ROMs.

4.1.4 Data Mining Strategy

The JCOBIAA JT&E will exercise a data mining strategy for obtaining C4ISR data required to populate the architecture assessment tools. The data strategy plan will support the JCOBIAA methodology process. The goal is to have data mining tools and the data mining strategy with documentation available no later than November 2004. It is expected that the strategy and data mining tools will be useful to Joint warfighters, the Services, CINCs, Joint Staff and other National Agencies to support Joint C4ISR architecture planning, modeling, architecture analysis, and system interoperability development. With the successful use of the data mining strategy, the JCOBIAA JT&E will make available the strategy to the users with supporting documentation.

4.1.5 Training Documentation

A formal training package is essential to assist the users of the methodology in the application of the tools for architecture assessment. The JTF staff, CINC staffs, Services, and the Joint Staff, will be provided the documentation to conduct their own assessments in support of their unique requirements.

The JCOBIAA JT&E team will identify and document C4ISR architecture assessment training requirements and potential enhancements to JTF Joint C4ISR crisis action planning training. As a result of the test events conducted during the JT&E, the team will gain expertise in the methods and processes needed to enhance joint operational training. The training program will be tested in realistic JTF Joint C4ISR planning conditions.

Upon completion of the JT&E, a detailed training package will be provided to the proposed users on the procedures to conduct an architecture assessment using the JCOBIAA methodology. This includes:

- **Data mining strategy.** The toolkit is only as effective as the data that is used to populate the tools. Training will be provided on the strategy to obtain the C4ISR architecture data and the data mining tools that extract data and populate the tools.
- **Risk assessment procedures.** The risk assessment is done for the operational architecture and the integrated architecture. Training will be provided on the operation of tools and data analysis of the broad architecture assessment.
- **Dynamic and fine-grain analysis.** The dynamic and fine-grain analysis requires greater in depth analysis of the architecture, as well as the required data elements for the analysis and tools. Training will be provided on the operation of tools and data analysis, in particular, in the development of the desired measures and interpreting the output regarding architecture mission threads.
- **End-to-end testing procedures.** End-to-end testing of critical mission threads requires a greater understanding of the test laboratory environment. Training will be provided on the optimization of the distributed laboratory environment, laboratory scheduling, and system configuration.
- **Solution development.** Subject matter expertise, modeling techniques and end-to-end testing are necessary to give the Commander a credible recommendation to improve the architecture. Training will be provided on determining viable and realistic solutions to identified deficiencies in the C4ISR architecture. This requires an understanding of system configurations, mission requirements, and force capabilities in carrying out the mission.

The training would be incorporated into Joint and Service-sponsored exercises to train the warfighting staff. Training for Joint C4ISR architecture assessment in JTF Joint C4ISR planning would be recommended to Joint and Service schools to enhance curriculums.

4.1.6 Draft Joint Tactics, Techniques, and Procedures (JTTP) and DOTMLPF Input

Documentation of the JCOBIAA methodology baseline will provide the basis for developing a draft JTTP, how the architecture assessment process works, and what is needed to conduct the assessment. The lack of a current JTF architecture assessment process does not support the evaluation of refinements to existing Joint C4ISR planning doctrine. JCOBIAA JT&E will compile data that supports the JT&E findings and recommendations for the development of operational concepts and TTPs for JTF C4ISR architecture assessments to fulfill the JTF's planning requirements. The documentation will address the JCOBIAA methodology to enhance the JTF planning process. The users of this documentation will be the JTF staff and component staffs, combatant CINC staffs, the Services, and the Joint Staff.

During the JT&E, the test team will recommend changes to specific Joint publications, multi-Service publications, and Service manuals that should be revised based on JCOBIAA findings to the Joint Staff, Services, and agencies as appropriate. JCOBIAA will also produce the documentation for a new JTTP addressing Joint C4ISR architecture assessment.

4.1.7 Conclusion

Legacy products are a critical part of the JCOBIAA JT&E. The methodology is only valuable if the users are able to understand and use the toolkit in support of their unique requirements. Making a validated and effective C4ISR architecture assessment methodology available to the widest possible number of users is the primary goal. Also, providing updates and results of the testing is critical to the usefulness of the program. The data mining strategy would be valuable to a much wider user audience, and will be made available as soon as the validation is complete. Finally, providing detailed input into current and new JTTPs and a comprehensive training package will provide users across DoD the opportunity to maximize the use of the methodology in support of their requirements.

4.2 USERS

4.2.1 Overview

Potential users of the JCOBIAA JT&E legacy products include the Joint Force Commander (JFC) and Component staffs, Commanders in Chief (CINCs), Service staffs, Joint Forces Command (JFCOM), Training organizations, DoD, the Joint Staff, and the Acquisition community.

4.2.2 JTF Commanders, Components, CINCS and Services

Organizational echelons at the operational level of war are responsible for planning, integrating, synchronizing, and executing operations and will directly benefit from the JCOBIAA methodology. JTF C4ISR architecture assessments during crisis action planning and prior to employment will greatly benefit the JTF's situational awareness and mission execution through a more robust and reliable C4ISR architecture. The CINC's and Services will benefit from early assessments of their architectures in planning operations. The Combatant CINCs and respective JFCs and staffs will benefit from the results of the JCOBIAA test with the capability to conduct architecture assessments in the planning process prior to mission execution.

4.2.3 Doctrine Development And Training Organizations

Joint and Service doctrine development agencies will benefit from the results of the JCOBIAA JT&E through the development of JTTPs that support JTF architecture assessment and crisis action planning.

The operational and tactical units are organized, trained, and equipped according to their respective Service standards. Participants in the JCOBIAA JT&E will operate according to approved Joint and Service doctrine and TTPs. Service and Joint training exercises will benefit from architecture assessment techniques to improve C4ISR robustness from the JCOBIAA JT&E results as they train battle staffs on the JTF planning cycle. The JCOBIAA JT&E will provide the staffs of the Joint and Service training schools recommendations on how to enhance their training curriculum regarding architecture assessment techniques.

4.2.4 DoD and Joint Staff

Intelligence agencies and other DoD organizations will benefit from the JCOBIAA methodology by applying the JCOBIAA assessment methodology to their own unique part of the C4ISR architecture. The assessment of parts of C4ISR architectures will contribute greatly to the overall architecture effectiveness.

The Joint Staff will benefit from C4ISR architecture assessments through Joint system interoperability assessments and support to Joint Force operations through doctrine development.

4.2.5 Conclusion

Users of the JCOBIAA methodology and associated tools vary widely across DoD. Although the primary users are the JFC and Components, other organizations will benefit as well. The benefits of C4ISR architecture assessments at organizations such as the Acquisition community, Joint Staff, and training organizations will actually support a more effective and robust JTF C4ISR architecture. It is a win-win situation for all users involved in the Joint Test and in use of the legacy products.

4.3 INSTITUTIONALIZATION

4.3.1 Overview

The JCOBIAA methodology must be useful to the warfighter. If the methodology is not useful, it will not be institutionalized. If it is useful, it must be tested and validated. The JCOBIAA product implementation plan is a continuing process, successful only if the user is involved in the test. This is done by building a solid test team working with the warfighter and implementing subject matter experts (SMEs), and by staying in synchronization with the needs of the warfighting commands. **JCOBIAA is in the right position with its established Operational Advisory Group (OAG), USJFCOM as the legacy product owner, and the support from the combatant CINCs and their staffs to effectively institutionalize the methodology if the JT&E shows its utility and operational suitability.**

4.3.2 Dynamic Feedback To User Community

The JCOBIAA JT&E will not wait until all test events are completed to provide feedback or products to the user community. By utilizing web-based technology, having an ongoing, constructive dialogue with OAG users and C4ISR architecture SMEs, JCOBIAA will provide timely feedback and validated legacy products, when available, to the users. Specifically, JCOBIAA will provide a status on progress of data mining strategy in methodology execution, tool performance in architecture assessments, and JT&E data analysis. Also, JCOBIAA will encourage input and participation in the OAG, test events and the operational event. Feedback at all levels during the test will increase credibility in the test process and the JCOBIAA methodology.

4.3.3 Transition Of JCOBIAA JT&E Products

In anticipation of the end of the JCOBIAA JT&E effort, the JT&E will work with USJFCOM and it's designated assessment team to ensure long-term maintenance and enhancement of the JCOBIAA methodology and toolkit. Other areas of institutionalizing the methodology will be through drafting Joint Tactics, Techniques and Procedures (JTTP) for USJFCOM of the C4ISR architecture assessment process and identifying its place in JTF crisis action planning. Training documentation is key to ensuring the JCOBIAA process is documented and available to any user that may find benefit from architecture assessment analysis.

4.3.4 Conclusion

Figure 4.2 is a summary of the Product Implementation Plan that provides release date, benefits, and users for each test product. This plan is to help ensure that the legacy products get to the users as early in the test as possible.

Product	*Forecast Release*	*Benefits*	*Users*
Risk Tools & Handbook	FY03 Q4	Identify risk of C4ISR architecture on mission	CINC J6/Services
Dynamic Tools & Handbook	FY04 Q3	Identify impact of C4ISR architecture on mission	CINC J6/Services
Data Mining Strategy Release	FY05 Q1	Rapid population of architecture with current, accurate data	DoD-wide Community
Prototype Toolkit & Handbook	FY05 Q2	Integrated C4ISR assessment on mission	CINC J2/3/6 / Services Joint Staff J6
Methodology Training Manual	FY05 Q3	Exportable training to all users	CJTF/JFC
Assessment Process Input to DOTMLPF	FY05 Q3	Mechanism to implement long term solutions	USJFCOM J8 / Joint Integration & Interoperability (JI&I)
Stand up of Assessment Team	FY05 Q4	Integration into JTF planning process	CJTF/CINCs/Services/ Training/Joint Staff
Draft JTTP	FY05 Q4	Institutionalization of Assessment Process	ALSA/USJFCOM Joint Doctrine Wkg Grp

Figure 4.2 JCOBIAA Product Implementation Plan

The effort to have user involvement in the beginning of the JCOBIAA JT&E test, keep users informed throughout the test, and provide products, when available, during the test will keep the users engaged, interested, and support legacy product transition. Combatant CINC's involvement in the JT&E, USJFCOM's commitment to provide an assessment team to support JTF's, and the development of JTTPs and training packages will ensure that JTF's, CINC's, Services and the Joint Staff will be able to reap the benefits of having a Joint C4ISR architecture assessment toolset long after the JCOBIAA JT&E has concluded its test.

5.0 JOINT TEST RESOURCES

5.1 OFFICE FACILITIES AND LOCATION

5.1.1 JCOBIAA Feasibility Study Office Facilities and Location

The JCOBIAA Feasibility Study was established in the Joint C4ISR Battle Center (JBC). The JBC provides office space for seven individuals on the JCOBIAA team. It is also a former Chairman Controlled Activity. In fiscal year 1999, JBC became a CINC controlled activity reporting under USJFCOM. The JBC Commander reports to the Deputy Commander in Chief (DCINC), USJFCOM. JBC is located in the Joint Warfighting Center (JWFC)/Joint Training Analysis and Simulation Center (JTASC) in Suffolk, Virginia.

5.1.2 JCOBIAA Joint Test Force Office Facilities and Location

USJFCOM as co-sponsor and the Navy, as lead Service, will provide support for the JT&E. Facilities cost will be borne by the Navy. The JCOBIAA Test Director is considering two alternate facilities to house the test team: 1. A leased facility (known as the JT&E Center of Excellence) at 115 Lake View Parkway, Suffolk, Virginia near the JTASC, the Virginia Modeling and Simulation Center, and adjacent to the USJFCOM Joint Experimentation Center. JCOBIAA will be collocated with the Joint Warfighters (JWF) and Joint Battle Damage Assessment (JBDA) JT&Es. 2. An existing Navy facility within the Yorktown Naval Weapons Station, Yorktown VA, within commuting distance of JTASC. Pending a cost/analysis evaluation, expected to be complete in October 2001, the test team will remain at the JBC.

5.1.3 Test Facilities

The JCIF at JBC will be the primary Joint distributed test facility as shown in Figure 5.1. The Navy Space and Naval Warfare (SPAWAR) facilities located in the SPAWAR Systems Center, Building 3112, Charleston, SC will be one of the primary Service participants in distributed testing and will be integrated into a virtual network as shown in Figure 5.2. JCOBIAA will also utilize test facilities available through the Federated Battle Lab (FBL) network shown in figure 5.3. For end-to-end testing, the Joint Distributed Engineering Plant (JDEP) as it comes on line and FBL resources can be used. JITC maintains a liaison office with USJFCOM and will also be responsible for JDEP. Fine-grain analysis testing will be scheduled as needed through current scheduling processes. These facilities support operational architecture testing and exist internally at USJFCOM and externally through distributed connectivity with the FBL consortium. SPAWAR System Center, Charleston SC is also part of the network through its Integrated C4ISR test facilities and provides a test resource for testing integrated assemblies of C4ISR systems. A MOU has also been established with JFCOM to allow access to major training events and an operational event for the JT&E.

5.1.3.1 JOINT C4ISR INTEGRATION FACILITY (JCIF)

In coordination with all the major U.S. C4I systems program offices, the JBC has established a permanent JCIF. This facility includes the developmental versions of all major U.S. C4I systems found at the JTF echelon in a Joint Operations Center (JOC) and a Joint Intelligence Support Element (JISE). JCIF includes unaltered versions of the following DoD C4ISR systems. (JCIF is chartered to obtain all JTF C4ISR systems.)

- Joint Global Command and Control System (GCCS) Version 3.0.1 (SUN Solaris 2.5.1 operating system)
- Joint Deployable Intelligence Support System (JDISS) 3.0 (SUN SOLARIS 2.5.1 operating system and WINDOWS NT operating system)

- Information Dissemination Management (IDM) Release 2 (SUN SOLARIS 2.5.1 operating system)
- Global Broadcast System (GBS) Phase 1 Test-bed (SUN SOLARIS 2.5.1 operating system)
- Air Force Contingency Theater Automated Planning System (CTAPS) Version 5.2.2 (SUN Solaris 2.5.1 operating system)
- Marine Corps Air Ground Task Force (MAGTF) System Baseline (MSBL) Version 1.1 (HPUX operating system)
- Navy Global Command and Control System Maritime (GCCS-M) Version 3.1.1 (HPUX operating system)
- Army All Source Analysis System Remote Workstation (ASAS RWS) Version 3 (SUN Solaris 2.5.1 operating system)
- JTF Collaboration server, InfoWorkSpace (IWS), (SUN Solaris 2.5.1 operating system)

The JCIF is physically secured at the US SECRET SYSTEM HIGH mode and meets all DoD policies for administrative, cryptologic, physical, personnel, and emanation (TEMPEST) and information security requirements. External links are also secure at system high.

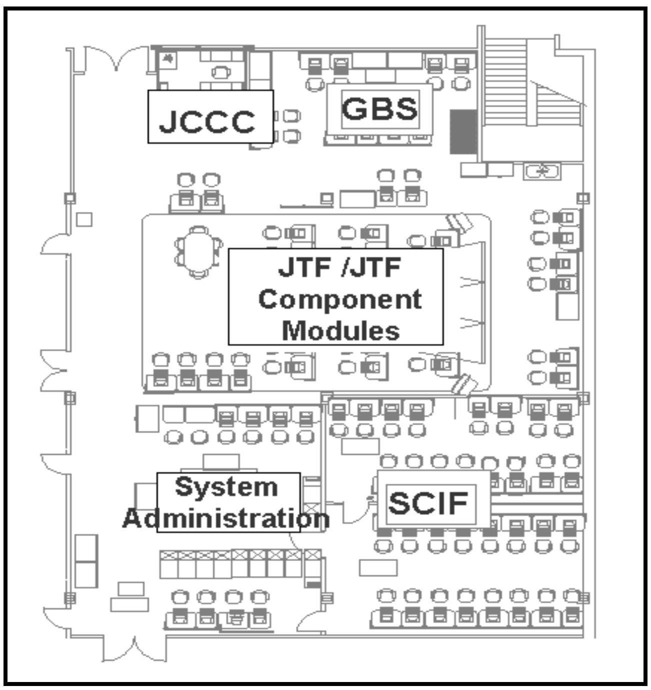


Figure 5.1 Joint C4ISR Integration Facility (JCIF)

Sensitive Compartmented Information Facility (SCIF): The JBC has outfitted a world-class SCIF within the JCIF. The objective is to provide a facility that can emulate the requirements and configuration of **any** CINC JTF Commander. This facility will be available to the JT&E. As part of the FY-01 ISR Program Development efforts by the JBC, from 13-16 March 2000, the JBC SCIF hosted Defense Intelligence Agency (DIA)-sponsored Collection Management (CM)/Intelligence, Surveillance, and Reconnaissance (ISR) Tools Conference. SCIF supported "hands on" demonstrations of Planning Tool for Resource Integration, Synchronization and Management (PRISM), Collection Requirements Management System (CRMS), Automated Collection Plan Generator (ACPG) and the External User Interface (EUI).

Briefs were provided for the Battlespace Visualization Initiative (BVI) and the Integrated Collection Situational Awareness System (ICSAS). In support of ISR assessment efforts, the following systems have been integrated into the SCIF operations: JBC Joint Worldwide Communications System (JWICS) website; JBC Plain Language Address (PLA) activated as SSO JBC; Joint Deployable Intelligence Support System (JDISS) NT Servers (5 ea); JDISS NT Workstations (7 ea) (20 Users); Broadsword (USAF Intelligence PORTAL); Ocean Surveillance Information System Evolutionary Development/Radiant Mercury (OED/RM). Planned SCIF infrastructure upgrades include: Information Support Server Environment (ISSE) Guard, Trusted Workstation (TWS), and Intelink Web Guard. SCIF infrastructure will support the JT&E.

The Joint Task Force Virtual Network is also available as part of a JCIF resource. This network provides connectivity to the battle labs and can be used to support fine-grain analysis and end-to-end testing. Figure 5.2 is a graphical description of the network.

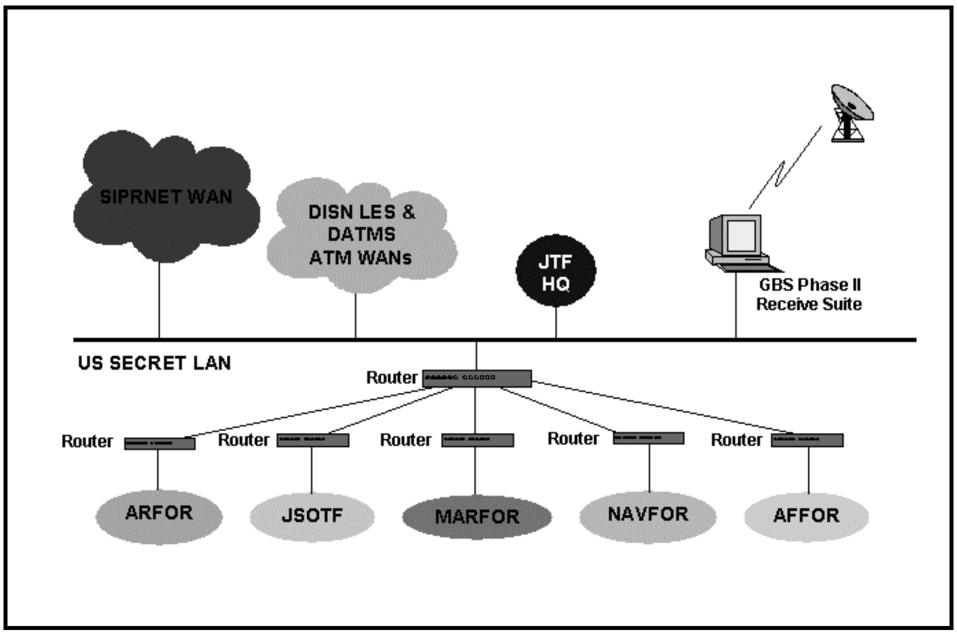


Figure 5.2 JTF Virtual Network

5.1.3.2 SPAWAR C4ISR Laboratory

SPAWAR Systems Center, Charleston is the Navy co-sponsor for JCOBIAA and operates the Navy's East Coast C4ISR laboratory located in Charleston, SC. This facility is capable of conducting system-of-systems testing that can be integrated in a laboratory or in a virtual network of laboratories linked via ATM and other high speed networks as shown in Figure 5.2. This facility has current memorandums of agreement with Army and Air Force facilities supplying similar services and will be able to provide joint capability for various test initiatives.

5.1.3.3 Federated Battle Laboratories

The JBC is the chair of the Senior Steering Group (Figure 5.4) that manages the Federated Battle Laboratory, a consortium of C4ISR Service laboratories, as shown in Figure 5.3. Availability of this capability to the JCOBIAA JT&E will allow for distributed testing of C4ISR systems to validate deficiencies and solutions that are predicted by the toolset or observed in test event exercises of the Joint C4ISR architecture. As discussed in paragraph 5.1.3, these facilities are test resources to support fine-grain analysis and represent some of the Service and combined integration facilities discussed in Section 2.4 of this document. JBC has Memorandums of Agreement (MOAs) with these battle laboratories that allow for conduct of JCOBIAA test activities. The purposes of the FBLs are:

- Leverage the efforts of the individual Service Battle Labs
- Provide efficiencies to Joint and Services programs by identifying facilities and teaming arrangements for cooperative testing and analysis
- Provide a coherent Joint context to enhance Joint aspects of testing and analysis

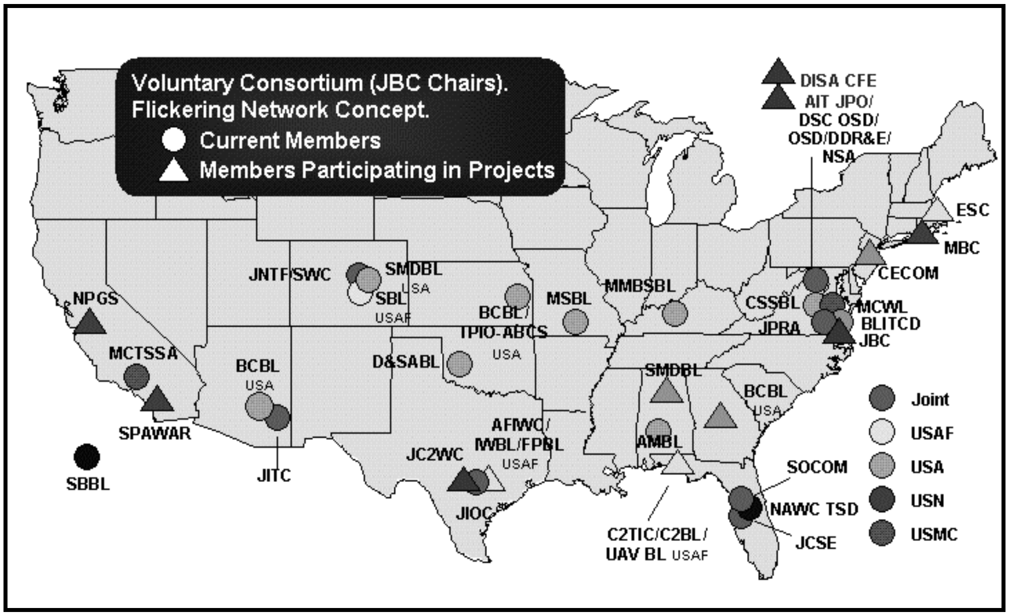


Figure 5.3 **Federated Battle Laboratories**

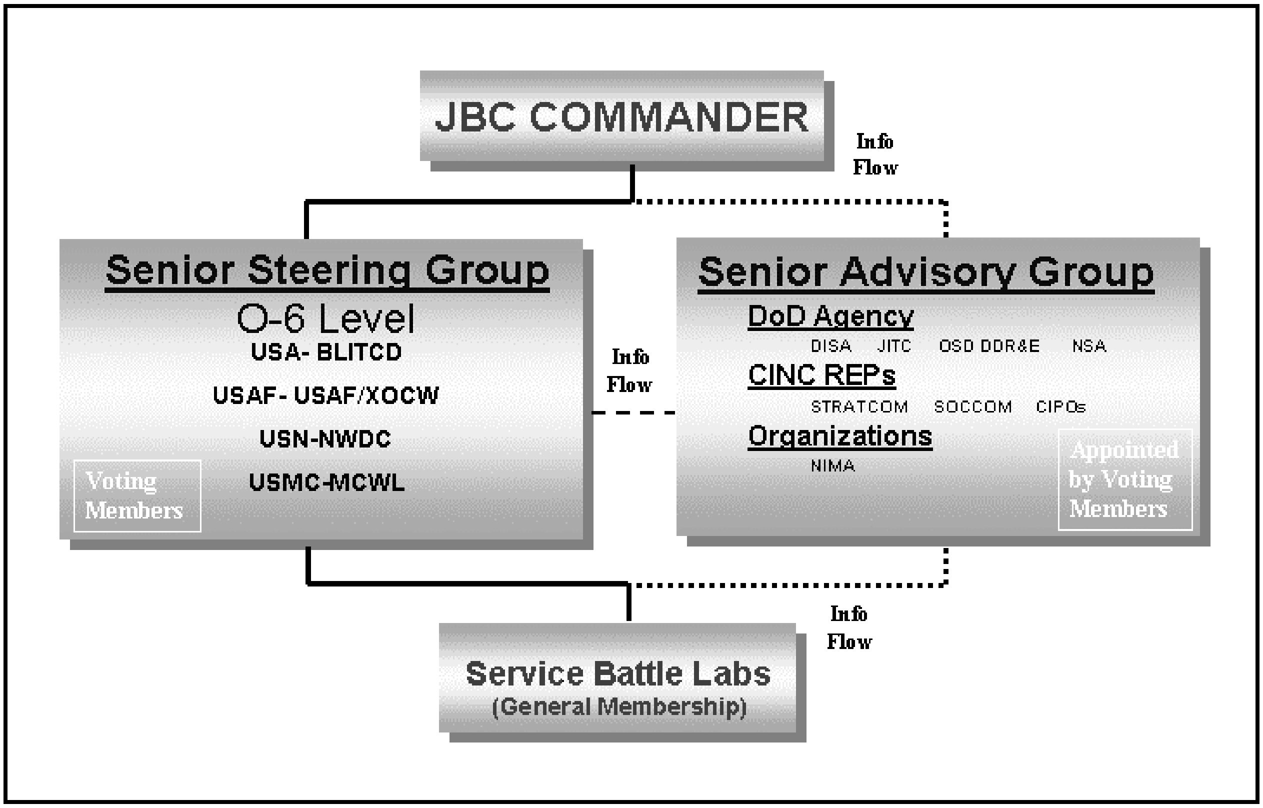


Figure 5.4 FBL Management Structure

5.1.3.4 JOINT INTEROPERABILITY TEST COMMAND (JITC)

JITC is the DoD facility for evaluating the interoperability of information, communication and intelligence systems. It also conducts a wide range of developmental, operational and standards conformance tests for DoD, private industry and several federal agencies. JITC performs independent and operational testing such as:

- Standards conformance testing
- Joint Interoperability testing and certification
- Performance testing
- System effectiveness
- Operational testing

JITC has a liaison person at JFCOM and is working closely with USJFCOM on integration and interoperability issues. JITC is a resource for data mining, testing and fine-grain analysis to support the JT&E.

5.1.3.5 JOINT DISTRIBUTED ENGINEERING PLANT (JDEP)

The JDEP is a collaborative tool and a distributed engineering plant to analyze and resolve engineering challenges. JDEP is evolving toward an application of engineering activities and functions connecting hardware, software, and personnel at geographically dispersed locations using telecommunications and network technology. JDEP is an enabler for replication of Joint Force architectures and can conduct collaborative engineering tests to resolve interoperability and integration problems and deficiencies. JITC and JDEP are working closely with USJFCOM and are a potential resource for testing and analysis. As discussed in Section 2.4, these facilities are part of the Battle Lab network.

JDEP's robust systems and sites as shown in Figure 5.5 can be connected to solve increasingly complex interoperability problems by replicating operational systems and scenarios. Benefits of this engineering tool are expected to include:

- Verification of system baselines under evaluation,
- Identification of deficiencies affecting warfighter capability
- Interim deficiency patches
- Interoperability metrics.

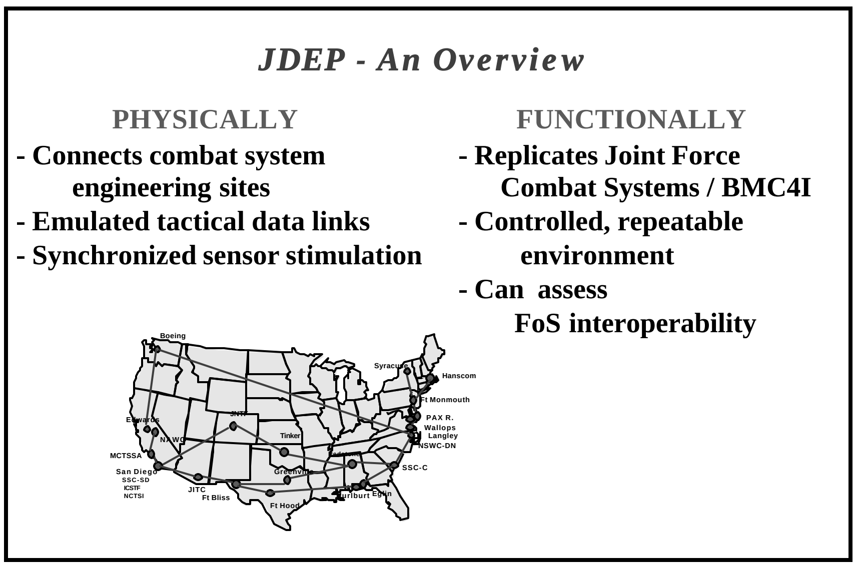


Figure 5.5 **JDEP Projected Sites**

JDEP has offered to provide facilities for use by JCOBIAA JT&E if and when they become available. This could potentially save some costs for the JT&E. The JT&E is, however, not dependent on JDEP.

5.1.3.6 NAVY DISTRIBUTED ENGINEERING PLANT (NDEP)

A precursor to JDEP, the Navy Distributed Engineering Plant is shown in figure 5.6. This engineering resource will be used for data review, studies and support for fine-grain analysis work. NDEP has three years of engineering architecture data and will be an excellent resource for data mining and to verify or leverage nodal testing. As an added benefit to the Joint community, JCOBIAA may make recommendations that Joint problems and deficiencies be coordinated with NDEP for potential resolution.

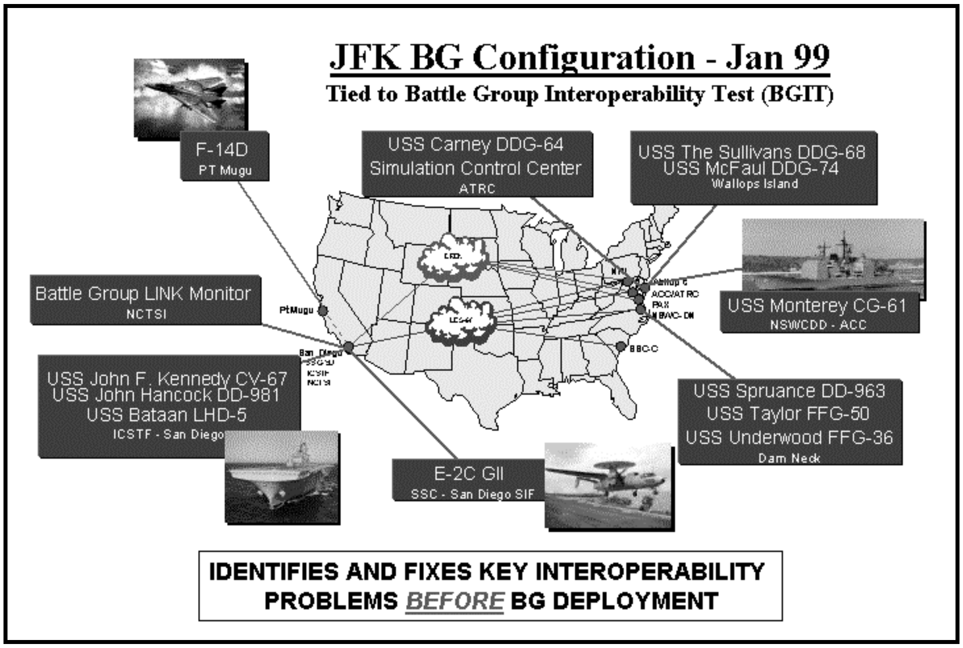


Figure 5.6 Navy Distributed Engineering Plant

SPAWAR participates in the NDEP, which is focused on the Carrier Battle Group. A brief history of the NDEP's first success is described below.

- The Navy Prototype DEP was brought together in 1998 to identify and fix key interoperability problems **before each Carrier Battle Group deployed overseas**.
- The DEP conducted its first Battle Group Interoperability Test, or BGIT, in January 1999, using the USS John F. Kennedy carrier battle group configuration.
- Software loads for the specific ships and aircraft displayed on the viewgraph were loaded in modules on the East and West Coasts, and connected via an ATM network.
- Successful identification of interoperability problems led to adoption of the BGIT principle for every deploying Battle Group.

Experience gained through the JDEP and the NDEP process will be available to the JCOBIAA test team to ensure end-to-end engineering test procedures are implemented. They also provide additional resources to the JT&E. In summary the test facilities available for JCOBIAA testing are robust enough to ensure testing over a broad spectrum of warfare levels in order to validate the methodology.

5.2 JT&E MANNING

The JCOBIAA Joint Test Team will be a dedicated full time test team that will manage all test planning, programming, execution, analysis, and reporting activities. The Joint Test Team will have approximately 40 people assigned when fully staffed. The team will have a mix of military, civil service, and contractor personnel. Table 5-1 summarizes personnel requirements and their sources. The Navy will provide the Joint Test Director O-6 billet.

SERVICE	OFFICER	ENLISTED	CIVILIAN	TOTAL
USA	2	1	0	3
USN	2	1	1	4
USAF	1	0	1	2
USMC	1	0	0	1
JFCOM	1	0	0	1
Contractor	N/A	N/A	29	29
TOTAL	**7**	**2**	**31**	**40**

Table 5.1 Personnel Requirements Summary

Each of the participating Services will appoint a Service Deputy or liaison which will serve as a focal point for their respective Service's concerns. Service deputies are each Service's senior representative, and function as experts on operations, tactics, techniques, procedures, resources, C4ISR architectures, and technical support capabilities. As indicated in Chapter 6, Service deputies will be dual-hatted with additional functional duties assigned within the test team.

5.2.1 JT&E Budget

OSD provides the majority of JT&E funding. The Navy, as lead Service, provides additional O&M funding primarily for facilities support costs. OSD's portion of the overall costs as well as the Service's portion are summarized in Appendix H, Consolidated Resource Estimate (CRE). Anticipated overall costs are summarized in Table 5.2.

Fiscal Year	FY 02	FY 03	FY 04	FY 05	FY 06	Total
Category						
OSD Costs	2232	4169	5144	5139	776	17460
Lead Service (Navy)	1358	1412	1456	1485	1056	6767
Army Costs	89	188	202	113	116	708
Air Force Costs	71	148	157	109	112	597
Marine Corps	34	72	76	41	43	266
Total ($K)	3784	5989	7035	6887	2103	25798

Table 5.2 Overall Program Costs

5.2.2 Resources Provided By Other Programs

An integrated C4ISR architecture can be extraordinarily complex depending on the size and mission of the Joint Task Force. In order to validate a C4ISR assessment methodology over a wide spectrum of warfare levels, test events must be conducted in a comparable complex operational environment. That environment is found in the exercise venues selected for the JT&E that cover both East (JTFEX 03-3) and West Coast (Team Challenge 04) deployments. A "real world" event supported by the Joint Communication Support Element (JCSE) is also planned sometime during a three month window in 2004. If a "real world" event does not occur in that window, a scheduled JCSE-supported CINC-level exercise will be used in that window as a JT&E event. In addition, end-to-end testing facilities such as the JCIF, the FBL, and initial elements of JDEP will provide additional resources for JCOBIAA. Data repositories (e.g. the JITC database, JBC's JRCOA database, the CINC's Joint C4ISR Architecture Planning System (JCAPS) database, etc.) are also available to support the analytical and empirical data requirements of JCOBIAA. The availability of most of these resouces has been arranged through a series of briefings by the FSD and documented through written and verbal agreements.

Supporting letters of endorsement received and expected are shown in Table 5.3 These resources and endorsements will contribute greatly to ensuring that the JT&E will be sucessful.

JCOBIAA JT&E Endorsements	Signed
Deputy CINC, US Joint Forces Command	★★★
Director, Warfare Requirements (OPNAV N7), USN	★★★
Commander Third Fleet, USN	★★★
Director of Information Systems for C4, HQ USA	★★★
DCOS for Communications and Information, HQ USAF	★★★
Asst Sec of Navy for RD&A, Chief Engineer, USN	★★
Commander, Signal Center, Ft. Gordon, USA	★★
Director, C2, Deputy COS Air & Space Ops, HQ USAF	★
Chief Information Officer, US Special Operations Command	

Table 5.3 Letters of Endorsement

6.0 JOINT TEST MANAGEMENT

This chapter describes how the JT&E will be organized to manage the test, report progress, and schedule events. The current JFS team is housed within the JFCOM Joint C4ISR Battle Laboratory (JBC), Suffolk, VA. JBC is part of the Joint Forces Command (JFCOM). Upon chartering, the Joint Test team tentatively plans to move into the DoD JT&E facility that currently houses the Joint Warfighters (JWF) and Joint Battle Damage Assessment (JBDA) JT&Es.

6.1 ORGANIZATION

A Navy O-6, CAPTAIN Roberta "Bobbi" McIntyre, currently the Joint Study Director, will head the JT&E Test team. USJFCOM provided the Study Director billet. Either the Army or the Air Force will provide the Deputy Test Director, an O-5. Each functional group in Figure 6-1 below will be headed by a military person and staffed by contractors who will be tasked by the Task Manager. The Technical Advisor will be a GS-15 or equivalent.

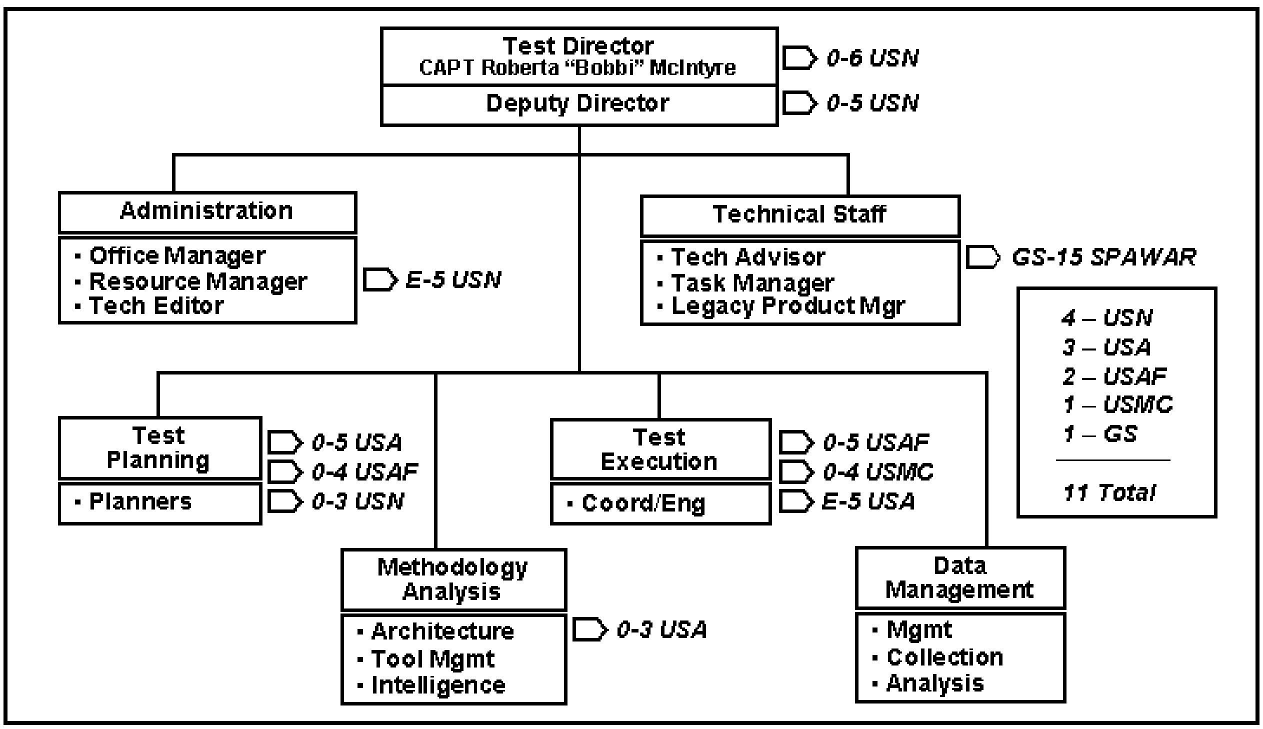


Figure 6.1 Joint Test Force Organizational Chart

6.1.1 Responsibilities Of Key Joint Test Force Members

6.1.1.1 Joint Test Director (JTD)

In accordance with the JT&E Handbook, the JTD is responsible for successfully executing and completing the JT&E and for achieving the JCOBIAA JT&E objectives on schedule and within budget. The JTD will coordinate all aspects of JT&E activities with Service components and provide test results and other JT&E products to OSD, the Joint Staff, the combatant commands, the Services, and other appropriate agencies. The JTD is responsible for the safe execution of test activities without adverse environmental impact. The JTD is responsible for developing and implementing a comprehensive operations security plan to protect sensitive aspects of the program. In the absence of the JTD, the Deputy Director will normally be in charge of JT&E activities. Other specific JTD responsibilities include:

- Develops the JT&E work breakdown structure (WBS) and schedule.
- Develops, maintains, and updates requirements for JT&E funding and Service support.
- Submits resource requirements to OSD/DD,DT&E and the Services as appropriate.
- Controls and accounts for funds designated for JT&E activities.
- Monitors Service expenditures related to the JT&E.
- Chairs the Data Certification Committee.
- Prepares and submits reports as appropriate, including progress reviews, interim test reports, the JT&E final report, and the JT&E management report.
- Prepares the JT&E legacy products to meet user needs.

6.1.1.2 Technical Advisor (TA)

The TA is the principal advisor to the JTD and the Joint Test Force on all technical matters pertaining to the JT&E. The TA is the focal point for all matters concerning test issues, measures, data collection and analysis and methodology. The TA advises the Deputy for Test Execution regarding analytic procedures and participates in the review and approval of test plans and reports. Specific responsibilities include:

- Provides technical advice to the JTD and division chiefs.
- Provides a technical interface with TAB members.
- Monitors test planning efforts and conducts technical reviews of test plans to ensure their feasibility and consistency with the JT&E concepts and issues.
- Conducts technical reviews of all JT&E analysis, findings, and conclusions.

6.1.1.3 Deputy Test Director/Chief of Staff (COS)

Duties of the Deputy Test Director/Chief of Staff include:

- Maintain coordination chain and POC list for Joint Test Force produced documents.
- Oversee Joint Test Force administrative, fiscal, logistics, security, and personnel functions.
- Prepare financial and progress reports to DDT&E.
- Prepare and coordinate Joint Test Force documents and reports.
- Prepare and coordinate Joint Test Force briefings.
- Distribute read-ahead copies of briefings to responsible agencies.
- Acts for the Test Director when appointed

6.1.1.4 Service Deputies

The Service deputies are dual-hatted positions and serve as both the senior representative from their Services and as Directors of Joint Test Force functional divisions. Duties include:

<u>Test Planning Director</u>

- Develop Program Test Plan (PTP)
- Coordinate plans with remote test site schedules

- Establish test team composition
- Establish MOAs/MOUs with test participants

Test Execution Director

- Ensure test team scheduling, transportation, lodging
- Establish data collection positions
- Ensure test equipment in place on time
- Ensure test equipment returned
- Functions as security POC for exercise

Data Management Director

- Ensures data collection plan tailored for specific test
- Trains data collection personnel and manages data
- Provide After Action Report (AAR)
- Maintains test data base

Methodology Analysis Director

- Ensures C4ISR architecture available prior to test
- Establishes data requirements for analytical toolset
- Conducts execution of analytical tool set
- Coordinates closely with local test site manager
- Provides Intelligence aspects of all tests

Additional duties of the Deputies in accordance with guidance provided by the JT&E handbook are as follows:

- Support the JTD in the conduct of the JT&E
- Ensure that own Service concerns are adequately addressed by the Joint Test Force
- Identify Service resource and personnel expertise required for execution of the Joint Test Force and ensure their availability.
- Coordinate within own Service to obtain required information and resources and obtain Service coordination on Joint Test Force documents and products.
- Provide advice and expertise to the JTD on Service issues and areas of interest.
- Obtain own Service coordination relative to Joint Test Force planning, conclusions, recommendations, and products.
- Provide progress and significant action reports to own Service.

6.1.1.5 Product Manager

JCOBIAA will institute a Legacy Product Manager position with duties as follows:

- Identify specific and any unique requirements of users
- Periodically provide products to the user
- Document and provide training package with each product
- Participate in training of first group of users in demonstration

- Provide plan to institutionalize methodology
- Reports directly to the JTD

6.2 REPORTS

It is the responsibility of the JTD to keep DD, DT&E and the JT&E Program Manager informed of program status to include problem areas encountered, solutions worked, outstanding problems, and assistance required. Required reports are outlined in the JT&E manual and listed in Table 6-1.

Document or Report	**Primary Responsibility**	**6.0 SUSPENSE**	**6.1 DESCRIPTION**
Progress Reports	JTF Chief of Staff	Due to DD, DT&E as required	Provides periodic updates to Joint Test Force activities
Financial Reports	Resource Manager	Due to DD, DT&E as required	Reports the Joint Test Force financial status
Program Test Plan	JTD	As established by JTD	Provides roadmap for all Joint Test Force activities
Data Management and Analysis Plan	Data Manager	As established by JTD	Orchestrates and guide data management efforts
Detailed Test Plan	Test Managers	As established by JTD	Provides detailed directions on test procedures for conducting activities
Activity Reports	Test Managers	As established by JTD	Documents results of test activities
Special Reports	JTD	As requested NLT 45 days after external requested information is available	Reports on problems that require immediate attention
Final report	JTD	Due to JT&E PM120 days prior to shutdown date of JT&E	Final assessment of programs issues
Management Report	JT&E PM	Due to DD, DT&E 30 days prior to shutdown of JT&E	Provide JTD conclusions, recommendations, and lessons learned
Special Reports	JTD	As required, e.g. death & injuries	Report to DD,DT&E

Table 6.1 Joint Test Force Reports

6.3 SECURITY

The JCOBIAA Security Manager is responsible for all aspects of security including security of all collected data as well as physical access to JCOBIAA facilities. The Security Manager will ensure each Joint Test Force member and participant possesses appropriate security clearances required for specific tasks. In the PTP, the Joint Test Force will prepare, publish, and implement a JCOBIAA Security Plan based on appropriate security classification guidelines defined in current versions of:

DoDS-5105.21-M	SCI Administration and Security
DoDD 5200.1-R	DoD Information Security Program
DoDD 5200.28	DoD Security Requirements for Automated Information Systems
DoDD 5205.2	DoD Operations Security Programs

DoDD 5220.22	DoD Industrial Security Program
AFM 14 series	Applicable USAF SCI Control, Protection & Dissemination
AFI 31 series	Applicable USAF Security Instructions and Pamphlets

The Security Manager will establish security procedures for access to, and handling of, data at each test site, as well as each data processing location.

The JCOBIAA Joint Test Force will use all appropriate Security Classification Guidelines (SCG) to screen JCOBIAA developed briefings and reports in order to assign appropriate classifications when necessary. Classification assignments apply to discussions regarding classified technology, capabilities, and performance measures. The Joint Test Force will comply with all security requirements for individual test sites. The exact number of required clearances has not been established, but there will probably be 20-25 positions which will require nothing above collateral clearances and as many as 20 positions that may require SCI clearances.

6.4 JOINT TEST SCHEDULE AND MILESTONE REVIEWS

The JCOBIAA test is a scheduled four-year program, as shown in Figure 6.2 (Recent funding constraints may require extended product development in FY 06 as shown in the CRE. Following the PTP, a Mini-Test using the JBC's JCIF and SPAWAR Systems Center-Charleston SC will be conducted in preparation for Test Event 1 (tentatively scheduled as JTFEX 03-3 which is a Joint exercise that features Navy, Marines, Army, and Air Force assets executing several JTF missions identified as high interest to the JCOBIAA Operational Advisory Group). In addition, prior to Test Event 1, the toolset will be populated with data and executed to predict expected deficiencies and identify potential solutions in the architecture. Predictions will be compared with observations in the test event. A similar analytical process will occur before Test Event 2 that is tentatively scheduled as Team Challenge 04 (a large complex Joint exercise with multi-missions and simultaneous JTFs executed by USPACOM in their Area of Operations (AOR)). The last major event in the JT&E will be an operationally oriented test of the methodology using a JCSE-supported FY05 operational event that could be JTF rehearsal or CINC-level Exercise.

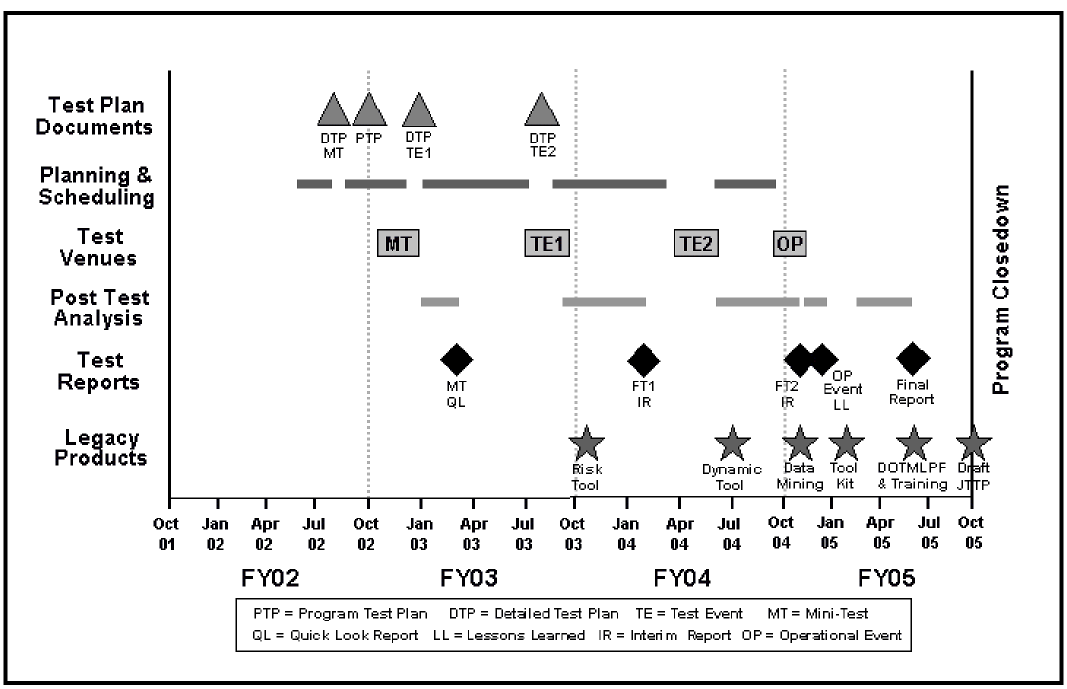


Figure 6.2 Joint Test Schedule

Milestone reviews for JCOBIAA will be held periodically to meet scheduled and unscheduled requirements of DD,DT&E including TABs, program advisors from the JT&E office, CINC's, JCOBIAA's General Officer Steering Committee (GOSC - chaired by Brig. Gen. James W. Morehouse, Director of Command and Control, Deputy Chief of Staff for Air and Space Operations Headquarters, U.S. Air Force), and JCOBIAA's Senior Steering Group (chaired by the Director C4 for JFCOM). The purpose of the GOSC is to capture and integrate Service representation in the JT&E at a senior level. The purpose of the JFCOM Senior Steering Group is to represent CINC requirements from the perspective of a Joint Force Provider, Integrator, and Trainer.

7.0 "IS FEASIBLE" RESOLUTION

7.1 FEASIBILITY OF THE JCOBIAA JT&E

The JCOBIAA Study Director was tasked prior to the Senior Advisory Council (SAC) meeting in July 2000 by the DD,DT&E/S&TS to assess the appropriateness of the JT&E program as a management venue for JCOBIAA. The JSD developed a point paper ("Joint Management Venue Alternatives", CAPT Roberta McIntyre, 21 March 2000) and briefed those results to the DD,DT&E/S&T and the SAC. Six different management venue options were investigated: Advanced Technology Demonstrations (ATDs), Advanced Concept Technology Demonstrations (ACTDs), Joint Test and Evaluation (JT&E), Joint Interoperability Test Center (JITC), Operational Test Agencies (OTA) and USJFCOM.

The criteria for selection were: Program Charter, Venue Mission, Access to Required Program Resources, and Rigor of Test Results. Criteria definitions are identified as follows:

- **Program Charter –** How well does the program charter (the reason the program was instituted) of each venue align with the stated JCOBIAA goal of evaluating current methodologies for assessing Joint C4ISR architectures in terms of mission outcome?
- **Venue's Mission –** Does each venue's mission align similarly with the JCOBIAA test? Does each venue's mission generally focus on this type of problem (current Joint C4ISR architectures), at this level (outcome-based), routinely or will it be an institutional stretch (outside the mission) that could cause the program to fail or to have a general lack of support?
- **Access to Required Program Resources** - Does each management venue work with and have access to, the level of test resources envisioned for this test? Examples are analytical desktop computers, FBLs, JTF C4ISR systems, and CINC-level Joint exercises such as JTFEX, Ulchi Focus Lens, United Endeavor, or Team Challenge? Will funding be a problem? What is the funding size of typical programs in each venue? What is the stability for a multi-year project? What are the priorities?
- **Rigor of Test Results –** Will the test results of each venue be accepted by CINCs and Joint Force Commanders as a credible C4ISR assessment for their theaters?

According to these criteria, the point paper concluded that the Joint Test and Evaluation venue was the most appropriate in terms of accomplishing the goals of the project. These findings were briefed to the DD,DT&E and the SAC in July 2000 and JCOBIAA was officially directed as a JFS.

According to the JT&E JFS Handbook, five questions need to be answered to determine if JCOBIAA is feasible:

1. **Are the resources (personnel, ranges, test items, etc.) available?**
2. **Can the JT&E be completed in four years?**
3. **Are the benefits gained worth the cost?**
4. **Can a solution be found and do the technologies exist to support the solution?**
5. **Is joint testing the most effective way to resolve the concepts or issues?**

These criteria were addressed and the findings are as follows:

Criterion 1 – **Are the resources (personnel, ranges, test items, etc.) available?**

<u>Findings</u>: **<u>Yes</u>** –With respect to resources, the Navy as lead service has committed to support JCOBIAA by providing funding for facilities and Naval personnel including the Test Director's Billet to participate in the test. JFCOM as Executive Agent has agreed to provide access to all worldwide JTF training venues for which it is responsible and access to the JBC's JCIF that will serve as a gateway to the FBL. Other Services have verbally agreed to provide required personnel as indicated earlier in Table 5.1. A complete funding and staffing plan to execute the JT&E has been developed in detail and is available in Appendix H as the Consolidated Resource Estimate (CRE).

Criterion 2 – **Can the JT&E be completed in four years?**

<u>Findings</u>: **<u>Yes</u>** —The JCOBIAA JT&E is designed as a four year program that will encompass a risk reduction event, a Mini-Test, two tests events, and an operational event as the primary means of accumulating data to answer JCOBIAA test issues. Sections 2 and 6 of this Joint Feasibility Study Report (JFSR) address the JCOBIAA test concept, program schedule, analysis approach and reporting schedules which all support a four year JT&E. Additionally, if a test event conflict occurs at a later date, there is a backup for each test event (Section 2.9). Even if a backup event were to be cancelled, the distributed laboratory test environment would allow meaningful, although not complete, data to be collected so that preparation time is not wasted. The distributed environment also adds a degree of flexibility that allows for possible schedule adaptations in preparing for the next test. The combination of a reasonable schedule, test event backups, a JFCOM-controlled JCIF, and a flexible distributed laboratory environment increases the probability that this JT&E can be conducted in four years. (Planning for a fifth year in the CRE is based on development of additional products.)

Criterion 3 – **Are the benefits gained worth the cost?**

<u>Findings</u>: **<u>Yes</u>** – C4ISR is a complicated subject and continues to grow in complexity as technology advances. Today's warfighter relies more heavily on command and control than at any time in the history of warfare. The future of U.S. military operations will be tied even closer to Joint C4ISR as the warfighter strives towards the Decision Superiority tenant of Joint Vision 2020. Rhetorically speaking, "How much is a pound of Command and Control worth?" How much is a single life worth? Lessons learned painfully show that lives are lost when C4ISR is inadequate. A methodology that can assess and improve the C4ISR architecture of a JTF prior to deployment will not reduce lives lost to zero, but it will reduce the risk. Tens of billions of dollars a year are spent on C4ISR systems; a methodology to ensure interoperability of these system prior to deployment can protect that investment and enhance the chances of success for the Joint Force Commander.

Criterion 4 – **Can a solution be found and do the technologies exist to support the solution?**

<u>Findings</u>: **<u>Yes</u>** - A considerable effort has been undertaken during the course of the JFS to demonstrate via a series of Proofs of Concept to the DD,DT&E and the TAB that JCOBIAA is technically feasible. The proof of concepts included: using JRCOA as a template to identify missing elements in a Joint Civil Support Architecture, executing the risk assessment tool JTIRA to identify high risk systems in a mission critical equipment string, and executing a dynamic analysis tool to predict the time for a critical message to reach its intended recipient. Criteria have been developed for analytical tool selection and test venue selection. Those criteria have been applied to select the tools to be used in JCOBIAA and the JT&E venues. Required data sources have been identified that will populate the JCOBIAA methodology toolset. Additionally, the tools have been evaluated to ensure they predict the high-risk areas in a representative Joint Combat Search and Rescue (JCSAR) architecture and produce outputs that can be measured. A data mining strategy has also been developed to ensure access to the required data in a timely fashion. Meetings have taken place at several major facilities that will take part in the distributed test environment to ensure that they can perform the necessary functions and collect the necessary data for a successful test.

Criterion 5 – **Is joint testing the most effective way to resolve the concepts or issues?**

Findings: **Yes** – As mentioned in the beginning of this section, the Joint Management Venue Alternatives Report addresses whether the JT&E was the appropriate management venue for conducting JCOBIAA. That report looked at other options that included ATDs, ACTDs, OTAs, JTIC and USJFCOM (Joint Experimentation or the JBC). The recommendation accepted by DD,DT&E was that JT&E was the appropriate venue for JCOBIAA. JT&Es typically address the types of broad CINC issues identified with JCOBIAA, funding from the Services and OSD is generally stable for the duration of the test sequence and the services are receptive to supporting JT&E with trained personnel. JCOBIAA deals with Joint Task Forces and needs a truly Joint test environment to establish credibility with the CINCs and with all the Services (anyone of which could be the Joint Force Commander).

7.2 RECOMMENDATION

The JFSR recommends the chartering of JCOBIAA as a JT&E to validate and improve a methodology to assess Joint C4ISR Integrated Architectures.

APPENDIX A
ACRONYMS

AC2ISR	Aerospace Command & Control Intelligence, Surveillance & Reconnaissance
ACPG	Automated Collection Plan Generator
ACTD	Automated Command Training Division
ADE	Analytic Decision Engine
ADNS	Automated Data Network System
AF	Allied Forces
AFOTEC	Air Force Operational Test & Evaluation Center
AIC	Architecture Integration Center
ALSA	Air Land Sea Application Center
AOR	Area of Responsibility
API	Application Program Interface
ARG	Amphibious Ready Group
ARSOC	Army Special Operations Center
ASAS RWS	Army All Source Analysis System Remote Workstation
ATEC	Army Test and Evaluation Command
ATD	Advanced Technology Demonstrations
ATM	Asynchronous Transfer Mode
ATO	Air Tasking Order
BGIT	Battle Group Interoperability Test
CADM	Core Architecture Data Model
CAP	Combat Air Patrol
CAPE	C4ISR Analytic Performance Evaluation
CAS	Close Air Support
CCRP	C4ISR Cooperative Research Program
CDC	Concept Development Conference
CDM	Communications Device Model
CEIF	C2 Enterprise Integration Facility
CINC	Commander in Chief
CISA	Command Information Superiority Architectures
COBP	Code of Best Practices
COE	Common Operating Environment
CDE	Common Desktop Environment
CIAP	Communications, Intelligence Architecture Plan
CJCS	Chairman, Joint Chiefs of Staff
CM	Configuration Management
CONOPS	Concept of Operations
CONPLAN	Operation Plan in Concept Format
COTS	Commercial Off the Shelf
CRE	Consolidated Resource Estimate
CRO	CINC Requirements Office

CSAR	Combat Search and Rescue
CTAPS	Contingency Tactical Air Planning System
CTSF	Central Technical Support Facility
C2	Command and Control
C4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance
DCINC	Deputy Commander in Chief
DIADS	Digital Integrated Air Defense System
DISA	Defense Information Systems Agency
DDM	DoD Data Model
DD, DT&E	Deputy Director, Developmental Test and Evaluation
DGSA	DoD Goal Security Architecture
DIA	Defense Intelligence Agency
DII	Defense Information Infrastructure
DIL	Digital Integration Laboratory
DISN	Defense Information System Network
DMAP	Data Management & Analysis Plan
DMS	Defense Message System
DoD	Department of Defense
DOT&E	Director of Operational Test and Evaluation
DOTMLPF	Doctrine, Organization, Training, Materiel, Leadership, Personnel, and Facilities
D,S&TS	Director, Strategic and Tactical Systems
DTN	Data Transmission Network
DTP	Detailed Test Plan
EEI	Essential Elements of Information
EEI	External Environment Interface
EMI	Electromagnetic Interference
ES	Equipment String
ESC	Electronic Systems Center
ETE	End to End
FBL	Federated Battle Laboratory
FOGO	Flag Officer/General Officer
FoS	Family of Systems
FPC	Final Planning Conference
FSD	Feasibility Study Director
FT	Functional Thread
GBS	Global Broadcast System
GCCS	Global Command & Control System
GLOMO	Global Mobile
GOSC	General Officer Steering Committee
GOTS	Government Off the Shelf
GUI	Graphical User Interface
HCI	Human-Computer Interface
HLFA	High Level Functional Areas
ICAP	Integrated Communications Access Package
IDNX	Integrated Data Network Exchange
IDM	Information Dissemination Management

IER	Information Exchange Requirement
IPL	Integrated Priority List
IETF	Internet Engineering Task Force
IOPT	Information Operations Planning Tools
IPC	Initial Planning Conference
ISR	Intelligence, Surveillanc e, and Reconnaisance
IT21	Information Technology for the 21st Century
IWS	Information Workspace
JAOC	Joint Air Operations Center
JATACS	JDISS Advanced Tactical Cryptologic System
JBC	Joint C4ISR Battle Center
JBDA	Joint Battle Damage Assessment
JCAPS	Joint C4ISR Architecture Planning System
JCATE	Joint Crisis Action Test and Evaluation
JCC	Joint Common Catalog
JCDB	Joint Common Database
JCIF	Joint C4ISR Integration Facility
JCOBIAA	Joint C4ISR Outcome-Based Integrated Architecture Assessment
JCS	Joint Chiefs of Staff
JCSE	Joint Communication Support Element
JDEP	Joint Distributed Engineering Plant
JDISS	Joint Deployable Intelligence Support System
JE	Joint Endeavor
JFC	Joint Force Commander
JFLCC	Joint Force Land Component Commander and Staff
JFMCC	Joint Force Maritime Component Commander and Staff
JFACC	Joint Force Air Component Commander and Staff
JFS	Joint Feasibility Study
JFSR	Joint Feasibility Study Report
JIC/JAC	Joint Intelligence Center / Joint Analysis Center
JI&I	Joint Interoperability and Integration
JISE	Joint Intelligence Support Element
JIT	Joint Interoperability Tool
JITC	Joint Interoperability Test Command
JOA	Joint Operational Architecture
JOC	Joint Operations Center
JOPES	Joint Operation Planning and Execution System
JOTID	Joint Operations Tactical Interoperability Database
JPC	Joint Planning Committee
JPN	Joint Planning Network
JRCOA	Joint Representative C4ISR Operational Architecture
JSOTF	Joint Special Operations Task Force
JSCP	Joint Strategic Capabilities Plan
JSIPS	Joint Service Imagery Processing System
JTASC	Joint Training Analysis and Simulation Center
JT&E	Joint Testing & Evaluation
JTF	Joint Task Force
JTFEX	Joint Task Force Exercise

JTIRA	Joint Tool for Interoperability Risk Assessment
JTTP	Joint Tactics, Techniques, & Procedures
JULLS	Joint Universal Lessons Learned System
JWICS	Joint Worldwide Intelligence Communications System
JWF	Joint Warfighters
JWFC	Joint Warfighting Center
LOA	Letter of Agreement
LOS	Line of Sight
LOU	Letter of Understanding
LL	Lessons Learned
MAGTF	Marine Corps Air Ground Task Force
MEU	Mission Essential Unit
MIS	Management Information System
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MOE	Measure of Effectiveness
MOP	Measure of Performance
MPC	Main Planning Conference
MRM	Maintenance Reporting and Management
MSEAV	Multi-Tier Simulation of Executable Architecture Views
MSP	Message Security Protocol
NATO	North Atlantic Treaty Organization
NCA	National Command Authority
NCTSI	Naval Center for Tactical Systems Interoperability
NDEP	Navy Distributed Engineering Plant
NETVIZ	Network Visualization Tool
NETWARS	Networks and Warfare Simulation
NIMA	National Imagery and Mapping Agency
NIPRNET	Non-secure Internet Protocol Routing Network
NMS	National Military Strategy
NOPLAN	No Operation Plan Available or Prepared
NRO	National Reconnaissance Office
NSA	National Security Agency
NSS	Naval Simulation System
OAG	Operational Advisory Group
OJT	On the Job Training
OPFAC	Operational Facility
OPLAN	Operation Plan
OPNET	Optimized Network Engineering Tools
OPORD	Operation/Operational Order
OSD	Office of the Secretary of Defense
OPTEVFOR	Operational Test & Evaluation Force
OPTEMPO	Operations Tempo
OTA	Operational Test Agency
PED	Processing Exploitation Dissemination
PIR	Priority Intelligence Requirements
POC	Proof of Concept

PRISM	Planning Tool for Resource Integration, Synchronization, & Management
PTP	Program Test Plan
RDBMS	Relational Database Management System
RFI	Request for Information
RMA	Reliability, Maintainability, and Availability
RMF	Risk Management Factor
SAC	Senior Advisory Council
SCG	Security Classification Guidelines
SCIF	Sensitive Compartmented Information Facility
SIPRNET	Secure Internet Protocol Routing Network
SME	Subject Matter Expert
SOF	Special Operations Force
SPAWAR	Space & Naval Warfare Systems
SSC	SPAWAR Systems Center
TAB	Technical Advisory Group
TACCSF	Theater Aerospace Command & Control Simulation Facility
TAMD	Theater Air & Missile Defense
TBD	To Be Determined
TCT	Time Critical Targeting
TDC	Theater Deployable Communications
TDL	Tactical Data Link
TPIO-ABCS	TRADOC Program Integration Office for Army Battle Command Systems
TPFDD	Time-Phased Force and Deployment Data
TTP	Tactics, Techniques, & Procedures
UJTL	Universal Joint Task List
USCENTCOM	US Central Command
USCINCPAC	US Commander in Chief, US Pacific Command
USEUCOM	US European Command
USJFCOM	US Joint Forces Command
USPACOM	US Pacific Command
VTC	Video Teleconference
VVA	Validated, Verified, and Accredited
WIN-T	Warfighter Information Network-Tactical

APPENDIX B
DEFINITION OF TERMS

Close Air Support (CAS)

Air action by fixed- and rotary-wing aircraft against hostile targets which are in close proximity to friendly forces and which require detailed integration of each air mission with the fire and movement of those forces.

COMBAT SEARCH AND RESCUE (CSAR)

A specific task performed by rescue forces to effect the recovery of distressed personnel during war or military operations other than war.

Combatant Command

A unified or specified command with a broad continuing mission under a single commander established and so designated by the President through the Secretary of Defense and with the advice of the Chairman of the Joint Chiefs of Staff. Combatant Commands typically have geographic or functional responsibilities.

Crisis Action Planning

The Joint Operation Planning and Execution System process involving the time sensitive development of joint operations plans and orders in response to an imminent crisis.

Deliberate Planning

The Joint Operation Planning and Execution System process involving the development of joint operation plans for contingencies identified in joint strategic planning documents.

Dendritic

The branching or treelike decomposition of an element down to its basic components.

Designated Support Agent

The organization or agency that is designated by competent authority to provide support to a JFS. Frequently referred to as the support agent.

Dynamic Analysis

Assesses contributions of C4ISR systems and architectures to mission effectiveness. It also provides assessment of dynamic C4ISR parameters and their interactions.

End-to-End Testing

Connects and tests systems in their operational configuration identified in the Joint C4ISR architecture. This analysis is used to examine and evaluate the C4ISR systems and mission strings identified as having risk to the architecture. Due to the time and cost to conduct end-to-end testing, this analysis would only be used as time permits in the JTF planning cycle.

Equipment String (ES)

Physical implementation(s) of Functional Threads.

Feasibility Study Team

The personnel who perform a JFS.

Feasibility Study Director (FSD)

The person appointed as responsible for the conduct of the JFS.

Fine-Grain Analysis

Provides detailed functional/mission thread analysis. This includes: analyzing interrelationships between the operational view and systems view of integrated architectures; identifying performance characteristics/shortfalls of a Joint C4ISR architecture; and focusing the assessment on identified problem areas.

Functional Area

A major area of related activity (e.g., Ballistic Missile Defense, Logistics, or C2 support).

Functional Thread (FT)

A FT describes a unique path for information delivery that includes the application through communications path to another application and is specified by the messaging and network protocols.

General Officer Steering Committee (GOSC)

A group of General Officers from the Services and CINCs interested in a particular JT&E issue or operational concept who are invited by the FSD to advise on issues of doctrine, policy, or tactics. The intent is to capture and integrate Service representation in the JFS at a senior officer level.

Information Exchange Requirement

A requirement for the content of an information flow. Associated with an IER are such performance attributes as information size, throughput, timeliness, quality, and quantity values.

Information Superiority

That degree of dominance in the information domain which permits the conduct of operations without effective opposition.

Integrated Data Requirements List

A composite of all data requirements (controlled and uncontrolled) required to calculate MLMs, MOEs, and MOPs and answer the JT&E issues.

Instrumentation

Equipment used during a test activity to collect and record data.

Issue

A question that a JT&E will answer to resolve the warfighter problem. The measures and data elements are designed to resolve the issues.

Joint

Connotes activities, operations, organizations, etc., in which elements of two or more Military Departments participate.

Joint Feasibility Study (JFS)

A formal study undertaken to determine whether a proposed JT&E should be chartered for execution by a Joint Test Force.

Joint Force Commander (JFC)

A general term applied to a combatant commander, subunified commander, or joint task force commander authorized to exercise combatant command (command authority) or operational control over a joint force. (Joint Pub 1-02)

Joint Staff

The staff under the Chairman of the Joint Chiefs of Staff as provided for in the National Security Act of 1947, as amended by the Goldwater-Nichols Department of Defense Reorganization Act of 1986. The Joint Staff assists the Chairman and, subject to the authority, direction, and control of the Chairman and the other members of the Joint Chiefs of Staff in carrying out their responsibilities.

Joint Task Force (JTF)

A joint military force that is constituted and so designated by the Secretary of Defense, a combatant commander, a subunified commander or an existing joint task force commander.

Joint Test (JT)

Those activities dedicated to addressing an issue or concept that was nominated by OSD, Joint Staff, CINC, or Services and had become chartered by OSD to be conducted as a JT. Characterized by test rigor and results credibility.

Joint Test Director (JTD)

The person appointed as responsible for executing a chartered JT&E and directing the efforts of the Joint Test Force.

Joint Test & Evaluation (JT&E) Nomination

The process used to bring joint issues and concepts to the attention of the D,T,SE&E.

Joint Test Organization

A formal organization led by a JTD and staffed by the Services for a specific time period to conduct a JT&E under the auspices of an OSD charter.

Measure of Effectiveness (MOE)

A quantifiable entity that expresses the effectiveness of a system or concept under test. An MOE can also be defined as an algorithm that uses data from execution of a JT collected to compute a quantity called the measure.

Measure of Performance (MOP)

A quantitative or qualitative measure of a system's capabilities or characteristics.

Mission

An objective together with the purpose of the intended action.

Mission Area

The general class to which an operational mission belongs.

Mission Level Measure (MLM)

A quantitative or qualitative measure of a system's capabilities or characteristics in terms of their effect on the mission of which the system is a part.

Needline

A requirement that is the logical expression of the need to transfer information among nodes (e.g., operational elements, system elements).

Network Centric Warfare

An information network that uses the advances in communication and computing technology to connect widely dispersed and diverse forces into an effective and coordinated team.

Node

A representation of an element of architecture that produces, consumes, or processes data.

Operational Node

A node that performs a role or mission

Outline Test Plan (OTP)/Test Resource Plan (TRP)

Those resource requirements documents used by the Army and Air Force respectively for users to specify personnel and equipment requirements to be used in the support of joint test activities.

Quick-Look

Those procedures established to assure that the amount and quality of data being collected during test activities is adequate.

Peacekeeping Operations

Military operations undertaken with the consent of all major parties to a dispute, designed to monitor and facilitate implementation of an agreement (ceasefire, truce, or other such agreement) and support diplomatic efforts to reach a long-term political settlement.

Reconstruction

A post test analysis process used to verify the accuracy of collected data by alignment of the data to conducted test activities.

Risk Assessment

The identification of high-risk areas in the architecture that require further analysis.

Senior Advisory Council (SAC)

An advisory body that reviews selected nominations, the results of JFSs and JTs, and recommends appropriate actions to the D,S&TS.

Service Deputy

A senior person appointed by a Service to participate in a JFS. This person serves as a functional member of the JFS and JT&E while representing the interest of the appointing Service and should be an 0-5 or 0-6 with test and evaluation experience and a background in the technical aspects of the JT&E.

Special Operations Forces

Those Active and Reserve Component forces of the Military Services designated by the Secretary of Defense and specifically organized, trained, and equipped to conduct and support special operations.

Systems Node

A node with the identification and allocation of resources (e.g., people, platforms, facilities, or systems) required to implement specific roles and missions.

Technical Advisor

A JFS member designated by the FSD to advise on technical matters and to resolve any technical differences of opinion within the JFS. The technical advisor is responsible for keeping JFS activities focused on chartered concepts and/or issues.

Technical Advisory Board (TAB)

A group of senior scientists, engineers, and analysts who advise the DD,DT&E, SAC, JT&E PC, FSDs, and JTDs on technical matters.

Technical Advisory Group (TAG)

An advisory body formed to provide direct technical support and advice to a JFS Director and JT&E Director. The TAG composition is similar to the TAB but is not as senior.

Test Activity

A collective term used to describe a total series of related tests or studies conducted to collect and analyze data. Test activities can range from analysis using studies and models to field tests that involve deployed combat units.

Test Manager

A Joint Test Force member responsible for the planning, execution and reporting of a specific test activity.

2.8.2 Time-Sensitive Targets (TST)

Those targets requiring immediate response because they pose (or will soon pose) a clear and present danger to friendly forces or are highly lucrative, fleeting targets of opportunity.

2.8.3 Unified Command

A command with a broad continuing mission under a single commander and composed of significant assigned components of two or more Military Departments, and which is established and so designated by the President through the Secretary of Defense with the advice and assistance of the Joint Chiefs of Staff.

APPENDIX C
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APPENDIX D
DATA SOURCES

D.1 OVERVIEW

Data is key to the JCOBIAA methodology and in the population of the toolset. This appendix identifies the likely data sources necessary to populate the tools to conduct the architecture assessment. The JCOBIAA methodology does not maintain a database of architecture data, but extracts the required data from the data sources when needed for a particular architecture.

D.2 BACKGROUND

JTF architectures are very complex and dynamic with numerous data elements that change as force structures and missions change. The JCOBIAA methodology requires timely and accurate data to drive the toolset and provide accurate and complete results to the warfighter. Due to the numerous locations of required data and the disparate formats the data is in, the JCOBIAA methodology does not attempt to store the architecture data in a database that would be maintained. Instead, it only extracts the data necessary from the data source when needed for a given architecture and assessment. MOAs between the JCOBIAA team and the required data sources will be signed to allow access to current data sources for the population of the toolset.

D.3 DATA LOCATION

Listed below are the data sources grouped by Service or agency with the location of the data included. This list is not all-inclusive, and will remain dynamic as new data sources are identified and the methodology is matured.

D.3.1 Army:

- TRADOC Program Integration Office for Army Battle Command Systems (TPIO-ABCS) operational architecture data, Ft. Leavenworth, KS
- Architecture Integration Center (AIC) data, Ft. Gordon, GA
- Digital Integration Laboratory (DIL) test data, CECOM, Ft Monmouth, NJ
- Joint Common Database (JCDB), CECOM, Ft. Monmouth, NJ
- PEO C3S, Ft. Monmouth, NJ
- Central Technical Support Facility (CTSF), Ft. Hood, TX
- Army Operational Test Command (ATEC) test data, Ft. Hood, TX

D.3.2 Navy/Marine Corps:

- SPAWAR System Center (SSC) Fleet Database, Charleston, SC
- SPAWAR Maritime Component Architecture data, San Diego, CA
- Naval Center for Tactical Systems Interoperability (NCTSI) data, San Diego, CA
- Operational Test & Evaluation Force (OPTEVFOR) test data, Norfolk, VA
- Marine Corps Systems Command, Quantico, VA

- Marine Corps Test & Evaluation Agency data, Quantico, VA

D.3.3 Air Force:

- Electronic Systems Center (ESC) integrated architecture data, Hanscom AFB, MA
- AC2ISR Operational Architecture data, Langley AFB, VA
- C2 Enterprise Integration Facility (CEIF) data, Hanscom AFB, MA
- Joint Air Operations Center (JAOC) Lab data, Langley AFB, VA
- AF Operational Test & Evaluation Center (AFOTEC) test data, Kirtland AFB, NM

D.3.4 Joint

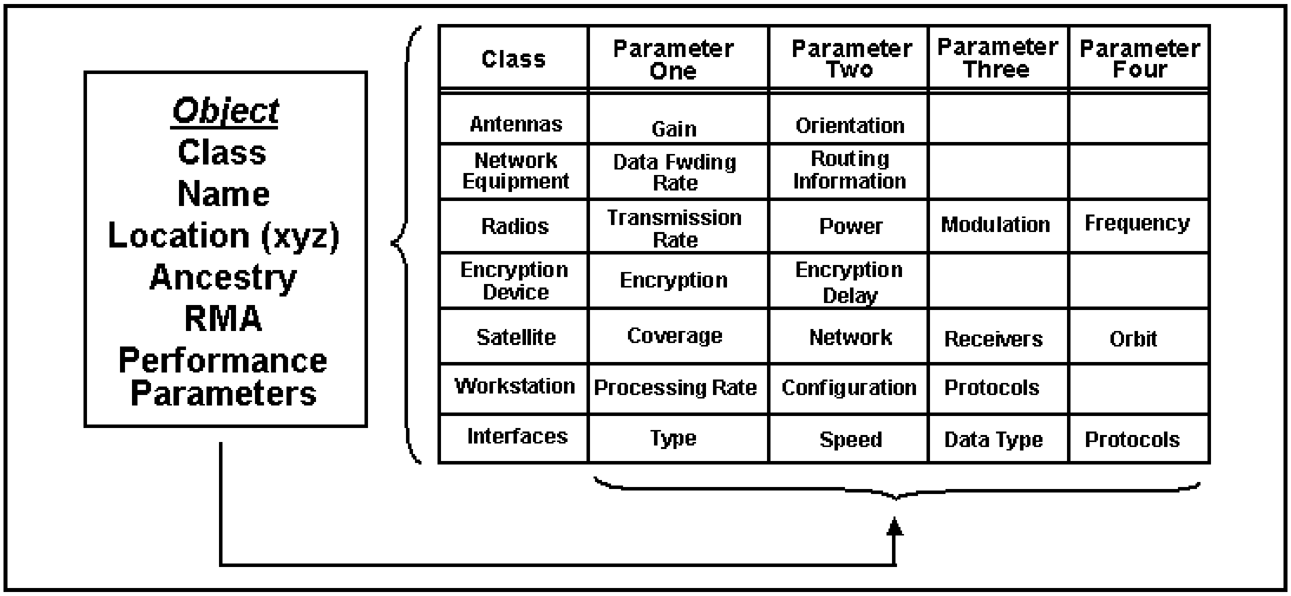
- Joint Common Catalog (JCC) Defense Information Support Agency (DISA)
- Joint Interoperability Tool (JIT), Joint Interoperability Test Command (JITC), Ft. Huachuca, AZ
- Office of the Secretary of Defense (OSD)
  - C4ISR Core Architecture Data Model (CADM)
  - Joint C4ISR Architecture Planning System (JCAPS) Universal DatabaseDefense Intelligence Agency (DIA) database
- Joint Staff
  - Task Orders (Doctrine, OPLANS, Joint Task Lists)
  - Network Warfare Simulation (NETWARS) Libraries
- US Joint Forces Command (USJFCOM)
  - Joint Communications Support Element (JCSE) data
  - JTF Representative C4ISR Operational Architecture (JRCOA)
- Joint Operations Tactical Interoperability Database (JOTID), NATO

D.4. DATA REQUIREMENTS

During the Proofs-of-Concept (POC) (Appendix G), data elements were identified and populated with the appropriate source data to run the tool. The results of the POC demonstrated the necessary data required to drive the toolset is available through the identified data sources.

Data model – The JCOBIAA data requirements to populate the various tools are composed of specific tool requirements for the JCOBIAA toolset (e.g., NETVIZ, JTIRA, CAPE, and TopView). Other projects were reviewed for data additions that may be needed, but which did not fit into the tools at this time.

Based on this, the data requirements for JCOBIAA follow:



Class	Parameter One	Parameter Two	Parameter Three	Parameter Four
Antennas	Gain	Orientation		
Network Equipment	Data Fwding Rate	Routing Information		
Radios	Transmission Rate	Power	Modulation	Frequency
Encryption Device	Encryption	Encryption Delay		
Satellite	Coverage	Network	Receivers	Orbit
Workstation	Processing Rate	Configuration	Protocols	
Interfaces	Type	Speed	Data Type	Protocols

Figure D.1 Object and Interface Data

The classes of objects can and will be expanded to allow the inclusion of subsystems that are deemed critical to the assessment of an architecture. Ancestry is the Parent/Child and hierarchical relationship entities are assigned or configured with. Additional data requirements are depicted in Figure D.2 below.

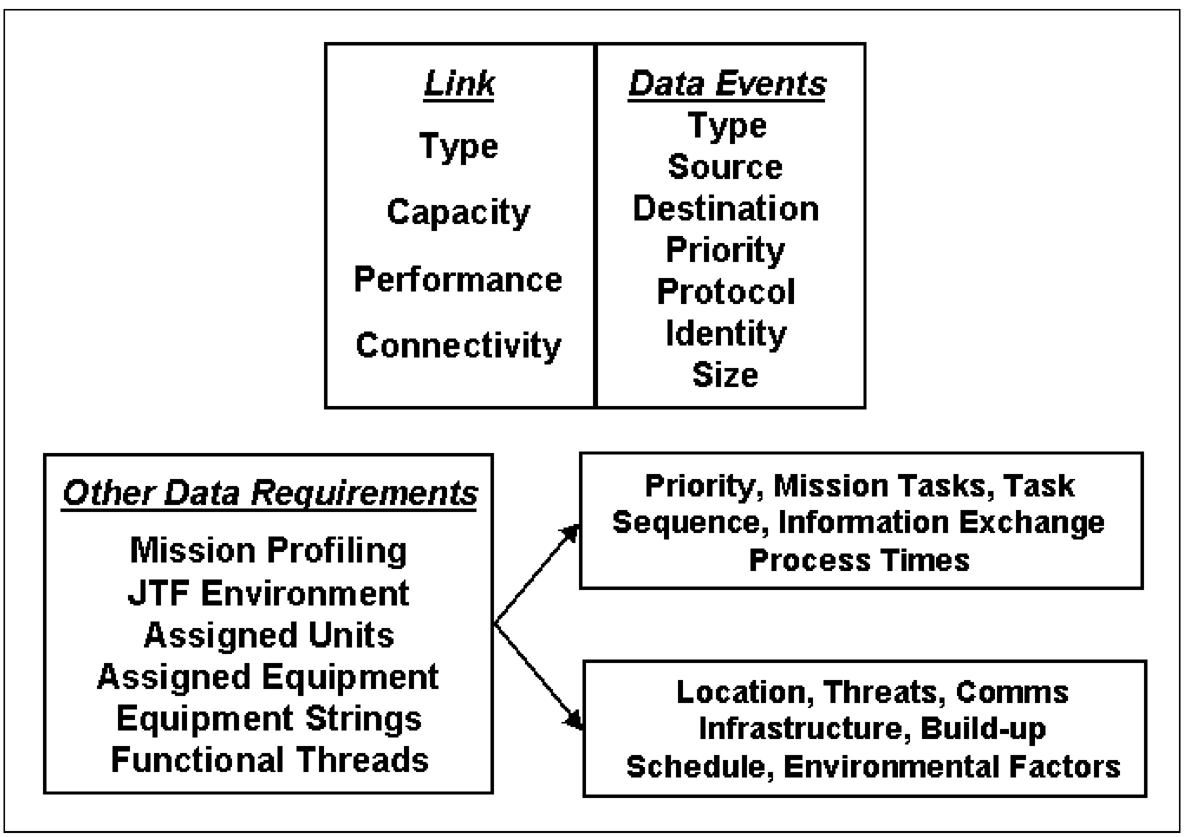


Figure D.2 Additional Data Requirements

Figure D.3 is a matrix of the key data elements grouped into categories needed to conduct the methodology assessment with the associated data source that can provide the data.

D.5. SUMMARY

Data is a key element of the JCOBIAA methodology, in which the data population of the toolset will be measured during the JCOBIAA test. The JCOBIAA study has demonstrated through several Proofs-of-Concept and agency/Service coordination on data resources that the data sources exist and the data is accessible to drive the methodology for the test.

Data Categories	Task Order	JRCOA	JITC JIT	Army AIC	AF ESC	SPAWAR	MCSC	Army DIL	DIA	TOPVIEW	JCIF	JITF
Command Relationships	X	X										
Operational Node Connectivity	X	X										
Information Exchange Rqmnts	X	X										
System Configuration/Lifecycle			X	X	X	X	X	X				
System Complexity			X	X	X	X	X	X				
System Proliferation					X	X	X	X				
Reliable/Maintainable/Avail					X	X	X	X				
Nodal Interrelationship				X	X	X						
Environmental Data	X								X			
Threat Data	X								X			
System Interactions			X							X	X	X
Activity Processes	X				X	X		X		X		
System Performance Data			X			X					X	X
End-To-End Configuration			X			X					X	X

Figure D.3 Key Methodology Data Categories And Sources

APPENDIX E
ANALYTICAL TOOLS

E.1 OVERVIEW

The JCOBIAA JT&E has a primary goal of addressing the architecture assessment problem facing the time-limited JTF planning process. Based on lesson learned from JTF operations, as discussed in previous sections of this report, undiscovered interoperability problems will continue to plague operations until the architecture is deployed and fielded. Research indicates that no single tool possesses the broad yet selectively focused accuracy when needed by the Joint Force Commander (JFC). The JCOBIAA methodology is based on a set of tools that will enable the JFC and his staff to identify the highest priority or critical deficiencies of the JTF architecture and employ detailed analysis tools or actual hardware and software testing when required to further examine risk and identify potential solutions.

The JCOBIAA methodology uses risk assessment tools along with dynamic analysis, fine-grain analysis, and end-to-end testing to analyze the JFC's Joint C4ISR architecture. The risk assessment tools identify high-risk areas in Joint C4ISR architectures that need to be examined in more detail. The objective is to suggest solutions to problems prior to the architecture being deployed, thus saving time and minimize impacts on the JFC's combat operations.

The JCOBIAA team has conducted a review and selected several tools for each step in assessing complex Joint C4ISR architectures. These tools satisfy the requirements at each level of a graduated architecture assessment. The following are the selection criteria that were used to select the tools for the methodology with detailed descriptions of each tool.

E.2 TOOL SELECTION

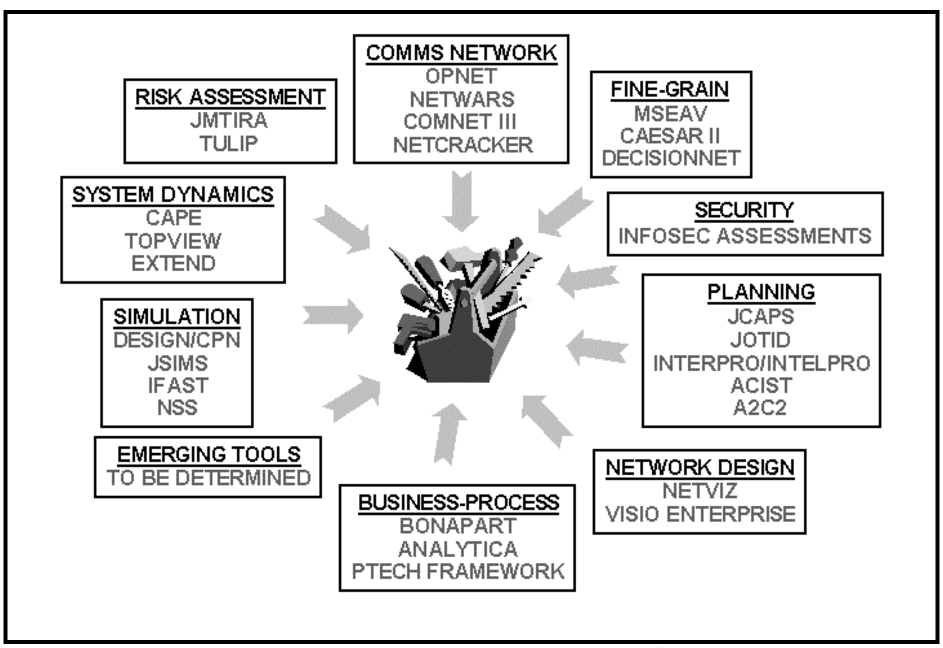


Figure E.1 JCOBIAA Tools Review

A process of research and analysis of software tools was used to determine the preliminary set of tools for the JCOBIAA methodology. Figure E.1 is a graphic depiction of the tools in each category that were assessed as potential tools for conducting this architecture analysis.

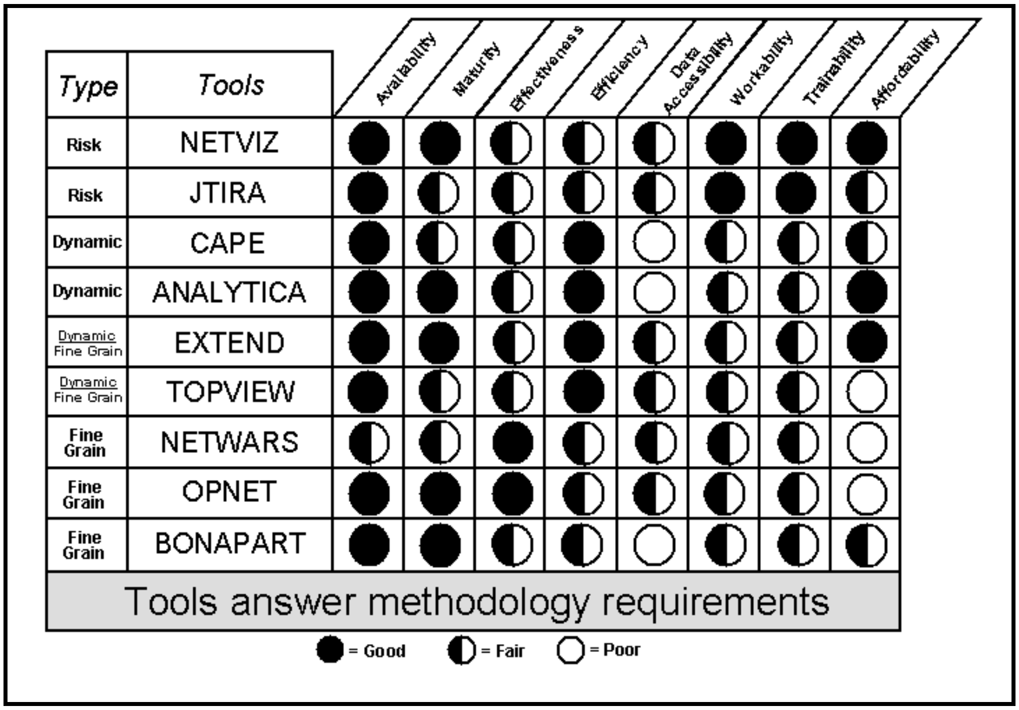


Figure E.2 Tool Selection Matrix

To select the necessary tools, eight criteria were established to assist in the selection process. While some tools were eliminated directly on their application's purpose, their databases were also examined in the course of the study. Based on the most promising tools, a matrix of assessment ratings (Figure E.2) was constructed to scope the tool selection.

- Is the tool available? It is important that the tool is obtainable and ready to use.
- Is the tool mature? The tool needs to not only be available, but fairly mature in its capability to perform the methodology requirements.
- How effective is the tool in meeting the assessment goals? The tool may be functional, but it needs to meet some level of the assessment requirements of timeliness, accuracy and completeness.
- How efficient is the tool in its functional analysis? The speed and performance/analysis characteristics are key features that need consideration. Data detail requirements play an important measure in efficiency.
- Data accessibility - Is the required data available? Data required to drive the tool must be available for the tools to be useful. And, how quickly can the data be accessed and translated? Some measure of accessibility and translatability of data to drive the tools must be considered.

- Is the tool prohibitively labor intensive? The tools cannot be too complicated for the assessment team to use.
- Is the required level of training prohibitive? The tool should not be used just by the designated assessment team, but also transportable to other desired users.
- Is the tool fiscally affordable? The tool must be affordable to not just an assessment team, but to any other desired users.

E.3 RISK ASSESSMENT TOOLS

The basis of the methodology is to use assessment tools to identify the highest priority and critical aspects of the JTF architecture and to then selectively employ more detailed modeling tools or actual hardware and software testing to further examine problems and identify solutions or mitigation procedures. The following are the selected risk assessment tools and their descriptions and contributions to the JCOBIAA methodology.

E.3.1 NETVIZ

NETVIZ is a COTS tool for graphically depicting logical and physical relationships of networks and organizations. It easily writes to and reads from a variety of common data structures, including text file, databases and spreadsheets. For the JCOBIAA JT&E it has the added benefit of being the tool used to build generic JTF architecture templates by DoD and Joint Staff (e.g., The Global Information Grid and the Joint C4ISR Battle Center's JRCOA).

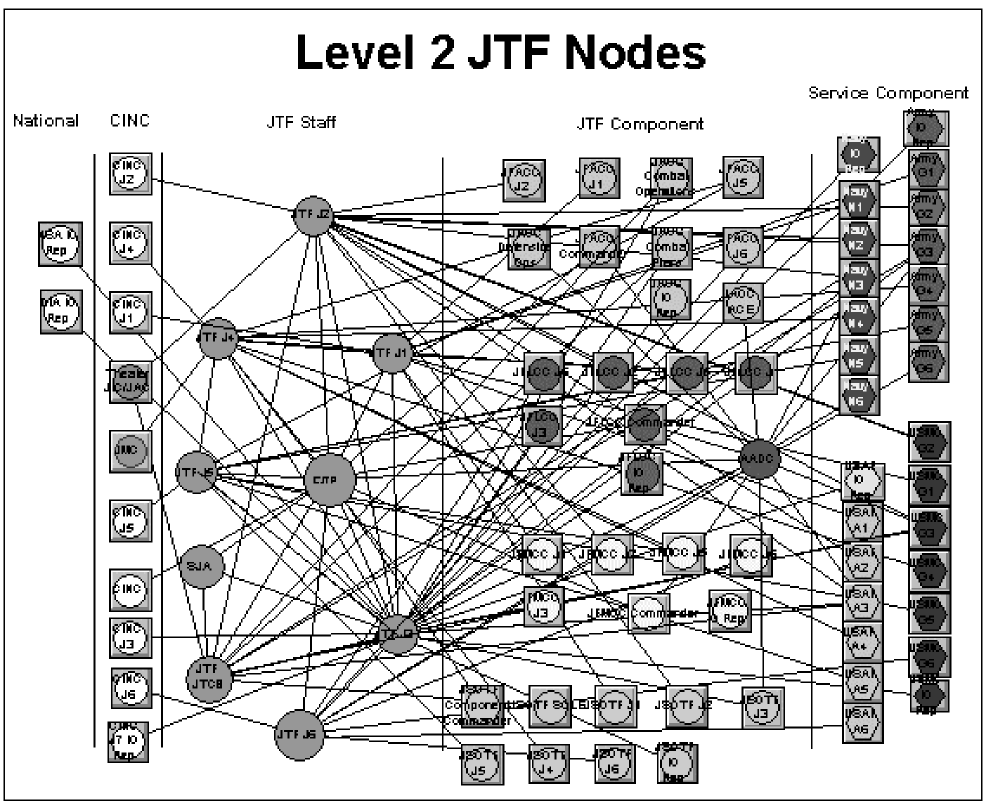


Figure E.3 NETVIZ Example (JBC JRCOA)

The pre-built models have command relationships and communication networks for common configurations. The JCOBIAA methodology uses NETVIZ to allow the JTF planners to enter the operational architecture and examine it for errors of omission against doctrinal templates. If networks architectures have been designed, they could also be entered into NETVIZ. Since NETVIZ writes to databases that the JTIRA tool can read, the output will make JTIRA data entry easier. An example of a NETVIZ architecture description is shown in Figure E.3.

E.3.2 JOINT TOOL FOR INTEROPERABILITY RISK ASSESSMENT (JTIRA)

E.3.2.1 Overview

The goal of JTIRA is to provide JFCs with a decision tool that organizes, tracks and summarizes system data and mission objectives into an interpretable risk value. This mission-associated risk value could then be used to prioritize subsequent investigation and testing as well as to pinpoint high-risk components of the JTF's complex, integrated architecture. The JCOBIAA methodology is to apply a systems engineering approach to Joint C4ISR architecture assessments by applying JTIRA as an integral part of the broad, initial assessment toolset. The JTIRA method will identify high-risk areas (areas requiring further investigation) in the context of the integrated architecture of the JTF. An example is to highlight a system with a high risk to fail and to associate that system with the missions it is a part of. Further investigation can then be accomplished to verify and isolate the problem through testing with either the actual systems (if available) or with a combination of real and proxy systems and networks. The actual configuration depends on the risk areas in question and the availability of assets (JTF systems and personnel) and time (until employment) to the JFC. Evidence of the viability of this approach of using JTIRA has been demonstrated at SPAWAR SSC Charleston, which successfully planned, built, and executed a distributed military test network beginning with Y2K testing in 1998. By associating an architecture deficiency with a mission, an End-To-End (ETE) (source to receiver) discovery and testing approach provides a useful level of risk mitigation that can transcend isolated system-level testing to operational implementation.

E.3.2.2 The Use of Risk Assessment

The risk-based approach is seen as an economical method to provide a broad, initial assessment of a complicated architecture. The focus on an integrated architecture associates system deficiencies to mission priorities and thereby provides a prioritized test approach that can be applied specifically to fine-grain analysis tools or ETE test processes. JTIRA can output results in a variety of ways to aid decision-making by the JFC and his operational planners and system managers. The results of the risk assessment and the equipment strings involved (system-to-system link) will be directly measurable and verifiable through live exercises and/or high-fidelity simulations. The bottom line is providing the JFC with a method to improve his C4ISR architecture before deployment.

The risk assessment application uses an integrated architecture (system architecture associated with operational missions tasks) based on networks and configurations defined at the functional thread level (a total sender to receiver path of information required to accomplish a major part of a mission task). It is assembled from several equipment strings which themselves are one-to-one pairings. During the CSAR mission this could be the Request for Information (RFI)/intelligence update from the CSAR unit to the Joint Intel Center (JIC). While this is an important distinction in the analysis, the C4ISR systems are still characterized by inherent system engineering and by the system attributes. Applying interoperability attributes, the integrated architecture is exercised only to the extent that its interfaces or functional thread configurations (based on mission priorities) are exercised. As an architecture is further exposed to more detailed analysis and possible ETE testing, the interoperability testing logically augments any baseline system-level testing. It provides, not only confidence in the system engineering, but also the interaction characteristics of the specific system implementation in the larger architecture. To illustrate the JTIRA hierarchy of assessment, Figure E.4 depicts a prototype used in the JCOBIAA proof-of-concept.

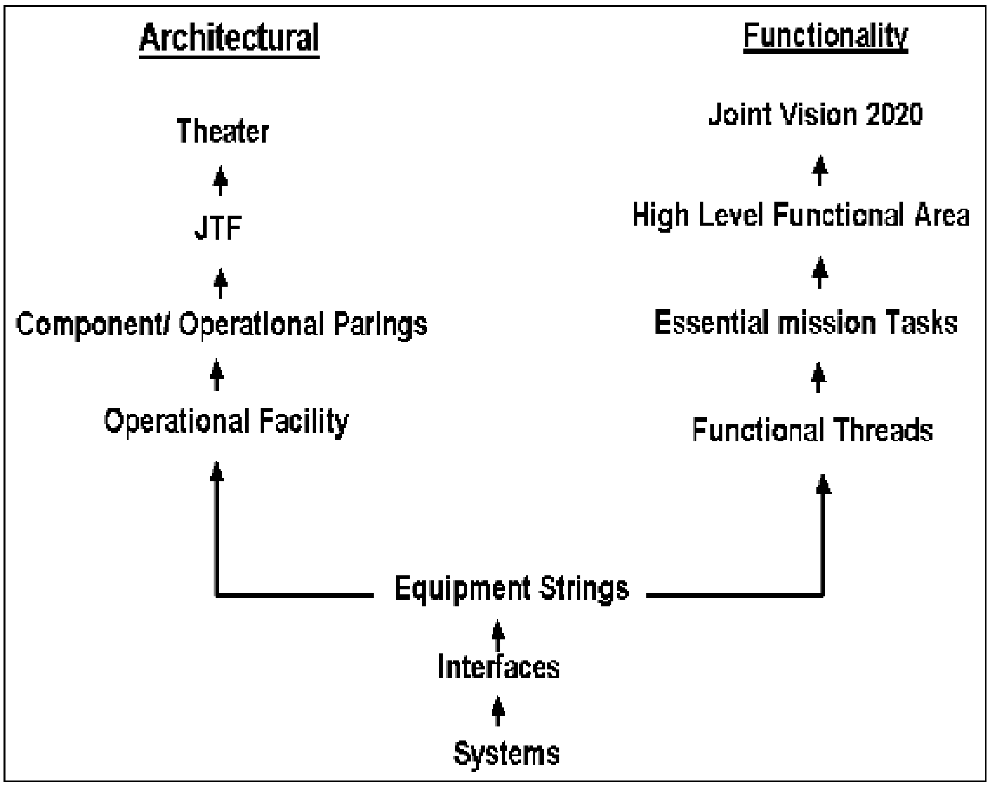


Figure E.4 JTIRA Hierarchy

E.3.2.3 Hierarchy Definitions

- ***System*** - At the lowest level of the hierarchy, a system is a set of components that cooperate to accomplish a task. (e.g., AN/TSC-100 SHF Troposphere satellite terminal, Wide Area Network (WAN), etc.).
- ***System Interfaces*** - logical and physical interconnections between systems. Physical interfaces exist between adjoining systems in a communications link and may include over-the-air links (HF, VHF, UHF, and EHF). Logical interfaces exist at the application level where data is processed, parsed, archived, or otherwise interpreted by the receiving system.
- ***Equipment String (ES) –*** Components connected in series. It includes the key systems, their interfaces and the connecting medium.
- ***Functional Thread (FT)*** - A unique path for information delivery that includes the application through communications path to another application and is specified by

the messaging and network protocols. The FT is associated to the Universal Joint Task Lists (UJTLs)

- ***Essential Mission Capabilities*** - The Essential Mission Capabilities are specific tasks (UJTLs). The Mission Capabilities are implemented across numerous networks using various information types (Information Exchange Requirements - IERs) and various physical paths. Functional Threads are associated with each essential mission capabilities
- ***High Level Functional Areas*** (***HLFAs)*** - HLFAs are those functional areas that must maintain integrity and quality in order to optimally carry out a mission.

E.3.2.4 JTIRA Basic Concept

JTIRA builds its risk values from System Inheritance, Mission Criticality, and Test results. The risk ranking is defined as the mean of the risk components shown in Figure E.5.

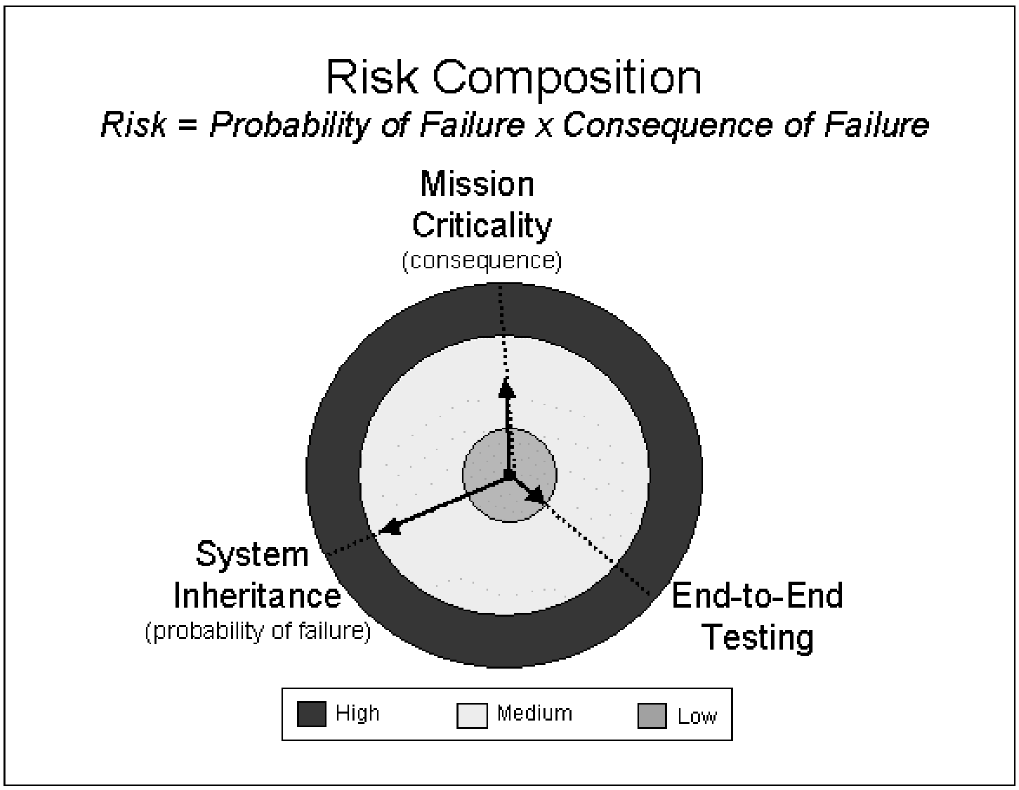


Figure E.5 JTIRA Risk Composition

- **System Inheritance** - A quantitative assessment of a system's inherent functional capability. Through expert assessment of applicable system-level data, the following functions were developed.
- **JTF Mission Criticality** - A quantitative assessment of the system's importance in the JTF architecture thereby representing the consequence to the JTF if that system fails. The following variables were deemed as indicators to JTF Criticality.
- **End-to End Testing** – The value is based on the results of testing of specific equipment.

E.3.2.5 Evolution of JTIRA

It was determined that JTIRA required a process to manage and feed back test results. Regression analysis was applied to determine what system attributes were significantly correlated to ETE test performance, and to what degree. When this type of statistical analysis is performed in cooperation with testing efforts, the feedback loop adds accuracy and confidence to the tool.

Regression analysis allowed JTIRA to make accurate predictions of failure probability for systems that were not yet tested. The effect of regression merged the System Inheritance and ETE Testability vectors in Figure E.5, resulting in a failure probability function of system attributes, refined and validated by actual ETE test results. System risk factors were developed by weighting system failure probabilities with JTF Mission Criticality.

E.4 DYNAMIC ANALYSIS TOOLS

The dynamic analysis will assess contributions of C4ISR systems and architectures to mission effectiveness. It will also provide assessment of dynamic C4ISR parameters (such as coverage areas of sensors) and their interactions (probability of detection given a target type and location). Dynamic tools use influence diagrams to provide a high-level way to evaluate the JTF architecture. These tools give results at a high level but in less time than results generated from a simulation model. This makes them ideal for analysis that has to be done in a very short period of time. The following are the selected dynamic analysis tools and their descriptions and contributions to the JCOBIAA methodology.

E.4.1 C4ISR ANALYTICAL PERFORMANCE EVALUATION (CAPE)

The CAPE methodology, while broad, is applied to the domain of C4ISR systems within the context of centralized decision-making. This limited domain shapes the purpose, scope, and uses of CAPE analysis (Kuskey, Mitre Report, Mar 00).

For the JCOBIAA project, CAPE models will be used to:

- Support top-level, cross-functional planning and analysis in a C4ISR organization, specifically the crisis planning of the JTF, where questions must be answered quickly, or be overcome by events.
- Provide to the JFC, a method to visualize, understand, and estimate the benefits of implementing choices for the organization of its C4ISR functions and systems.
- Support operational requirements and broad capabilities more than detailed system design. (Due to the constraints of time and events)

While CAPE is a family of tools that includes analysis of operational concepts, scenarios, environments, sensors, targets, collection processes, processing-exploitation-dissemination (PED) processes, command-control processes, communications, computers, and warfare processes, JCOBIAA will focus on Dynamic CAPE. This tool focuses on targets at risk (to sensors and attackers), attrition of platforms, and target detection number estimates.

The elements in CAPE analyses are predominately at the abstract level of aggregates, averages, and probability distributions instead of at the level of individual actors and events. To get results, categories of data required for input are:

- Theater Environmental Characteristics:
  Country
  Theater range bands
  Weather table
  Foliage table
  Terrain Masking table

- Operational Environmental Characteristics:
  Phase of conflict
  Operations tempo

- Target Characteristics:
  Target class table
  Target quality table
  Move time
  Concealment, Cover, Deception table
  Target value

- Collection Platform Characteristics:
  Duty cycle
  Altitude
  Range
  Collection rate
  Sensor resolution
  Collection efficiency
  Downlink capability
  Cueing

The results of CAPE analyses, stated in terms of measures of effectiveness and performance, are typically developed at the analytical level of averages (expectations) and sensitivity analyses.

E.4.2 TOPVIEW

E.4.2.1 OVERVIEW

The TopView modeling and simulation software supports rapid construction, execution, and iteration of C4ISR architecture models and simulations. TopView baseline libraries emphasize the sensors, systems and activities involved in C4ISR operations. It permits the user to assess the ability of current or hypothesized C4ISR systems and architectures to develop and deliver information that meets the accuracy and timeliness requirements needed to support the JFC and the operation.

TopView is a highly interactive development environment for creation, modification, and presentation of C4ISR architectures. It uses a graphical editor to construct and modify simulation entities (such as a satellite system, communication switching center, intelligence processing cell) create relationships between entities, establish data collection points (for real-world test design), conduct experiments of different architecture variations (sensitivity analysis) and analyze the results of the experiments**.**

The TopView simulation tool supports analyses which quantify the contribution of C4ISR data to JTF operations, viewed in the context of the communications architecture, and considering the coupling and enabling capability of theater and tactical systems. TopView maintains computer-based representations of currently deployed and the capacity to add future sensors, processing facilities, command and control systems, communications links, and weapon systems. TopView captures the essential capabilities of each of the component systems, their relationships and interactions with each other, and allows analyses of architecture performance to be completed which express results in operationally meaningful terms, such as timeliness, accuracy and cost.

E.4.2.2 TopView Description

TopView is an interrelated set of models and views of C4ISR architectures that provide different views of entities, how they relate and interact. TopView has four main views as shown in Figure E.6.

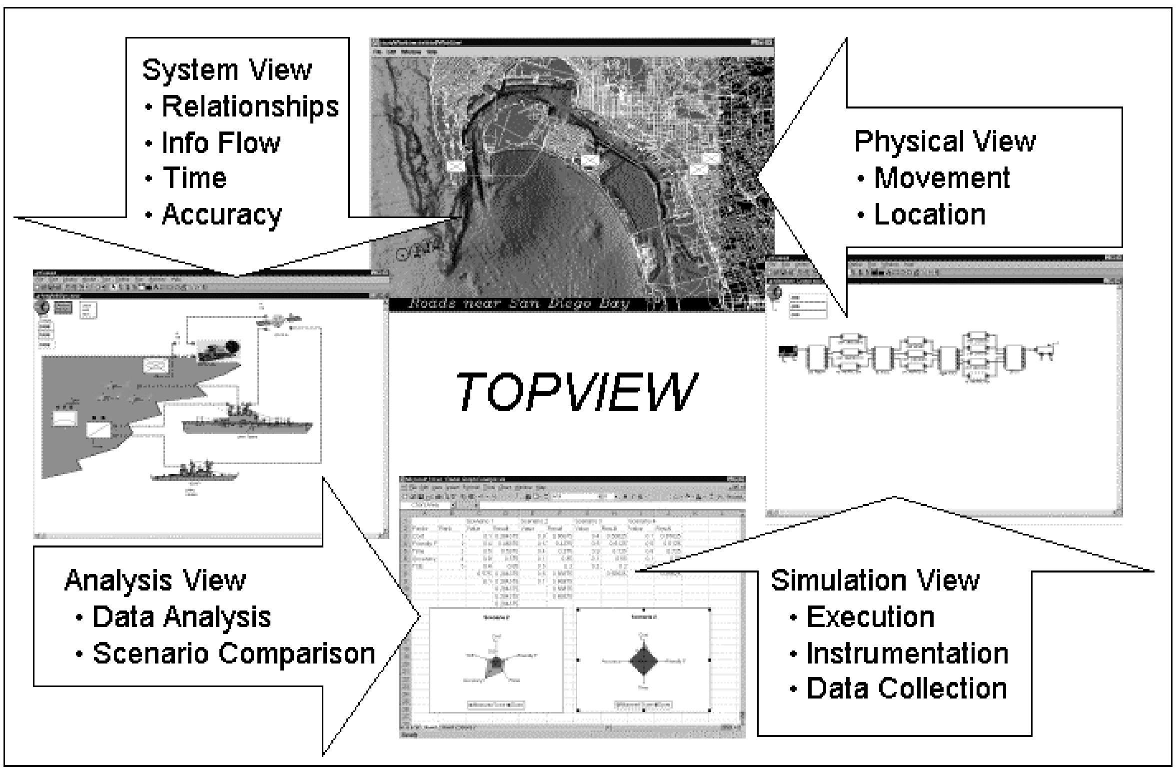


Figure E.6 TopView Views

The ***Operational View*** shows the location and interaction of participants. It simulates the geometric interaction between participates which includes sensors, mobility, targeting and communications. The sensor model simulates the detection of other participants, and includes location and range information. The mobility model allows participants to move in the physical battle space. Movement is accomplished by constructing waypoints along a line of movement. The targeting model (included in the operational model) classifies participants detected by the sensor model and determines if it can be attacked. The communications model is linked to the system view, which simulates the communications connections between, participants. The communications model in the operational view is used to determine if participates can actually communicate based on distance. The operational view also animates the movement and communications of the participants allowing the user to obtain a big picture of the operational use of the Joint C4ISR architecture.

The ***System View*** graphically depicts an executable system diagram of the interconnected systems and information process. These interconnections represent communications paths (e.g., Link 16, Link 11, UHF SATCOM) between military units (e.g., Platoon, Company), and/or systems (e.g., GCCS, JSTARS, TOC). The system view deals with timing of information movement and the transformation of information as it moves through the architecture. These transformations can include sensor data processing, command decisions and weapon targeting data. The system view is constructed as a hierarchy with a general top level view that can be viewed at lower and lower levels of detail by opening the hierarchical blocks.

The system view contains a full array of building blocks for rapid C4ISR architecture model development and execution. The TopView system view software can also animate the flow of information to enhance perception of the information process. This helps in architecture evaluation. The system view also provides a means to integrate with other tools (e.g., to read from Excel files) to expand capabilities.

The ***Simulation View*** shows simulation icons and executes the underlying simulation. This view provides the calculations and data management to support the operational and system view. The simulation view includes simple math blocks (blocks are grouped functions and instructions in a single drag and drop cell, represented by an icon), e.g., "ADD"-to add two numbers, or complex blocks that represent a sub-system e.g., JMCIS. The simulation view also contains blocks for data collection and analysis that include file writing blocks, plotters to plot data, and statistical computation blocks, e.g., mean and standard deviation. All the mathematical calculations of time, movement, information routing, command decisions and system interactions are provided by the simulation view. It also controls the actual execution of the steps of the discrete events.

The ***Analysis View*** provides for rapid examination of alternative architectures and/or changes to a particular architecture. The analysis view provides a series of the graphical and tabular outputs that are aligned with the objectives of the analysis. These tools use input from the system and operational models to provide calculations of measures of performance and measures of effectiveness. The exact MOPs and MOEs are dependent on the objective of the analysis (e.g., Selected by JCOBIAA to assess the architecture). Typically these are measures of time, accuracy, cost, and overall warfighter utility. Like the other views of TopView the analysis view is constructed to provide rapid data reduction and easy to understand graphical depictions. They allow the user to perform multiple alternative trade analysis, detail examination of information flow, and plots of individual and combined MOPs and MOEs.

E.4.2.3 Summary

TopView is a computer-based JC4ISR assessment tool designed to provide a system engineering approach across an entire C4ISR *system of systems* process from sensor through weapon. It permits the user to assess the ability of current or hypothesized C4ISR architectures to support delivery of information that meets the accuracy and timeliness requirements needed to support the JFC's Crisis Action Planning requirements and the JTF mission.

E.4.3 EXTEND

Extend is a commercially available software program. It is a process and activity tool for both discrete event and continuous time modeling. While the basic code underlying Extend is ModL, the product contains sufficient pre-built functions in "blocks" that make coding not necessary for many applications. Since the previous discussion on TopView covered the Extend capabilities as enhanced by the TopView designers this will be brief. The basic difference is the basic Extend may offer a limited, but cost-conscious alternative to TopView.

E.5 FINE-GRAIN ANALYSIS

Fine-grain analysis tools use linked simulations providing a more detailed analysis of the JTF architectures. The fine-grain analysis will provide detailed functional and mission thread analyses. These include: analyzing interrelationships between operational view and systems view of integrated architectures; identifying behavioral and performance characteristics and shortfalls of C4ISR architectures; and focusing the architecture assessment on problem areas. Fine-grain tools are used in the methodology when the system dynamic analysis tools do not provide enough detail and when end-to-end testing is impractical. The following are the fine-grain analysis tools and their descriptions and contributions to the JCOBIAA methodology.

E.5.1 NETWORK WARFARE SIMULATION (NETWARS)

E.5.1.1 Overview

NETWARS is an integrated ability to perform communication network analyses. A corollary objective is to provide a validated Joint C4ISR simulation capability, including associated databases and underlying models, so that consistent studies of C4ISR architectures can be performed. Fulfilling these needs involves a complex communications simulation environment, which requires the integration of supporting models and databases from multiple sources (see Figure E.7). In support of the warfighter, NETWARS provides an ability to analyze the capability of joint communications architectures to support warfighting.

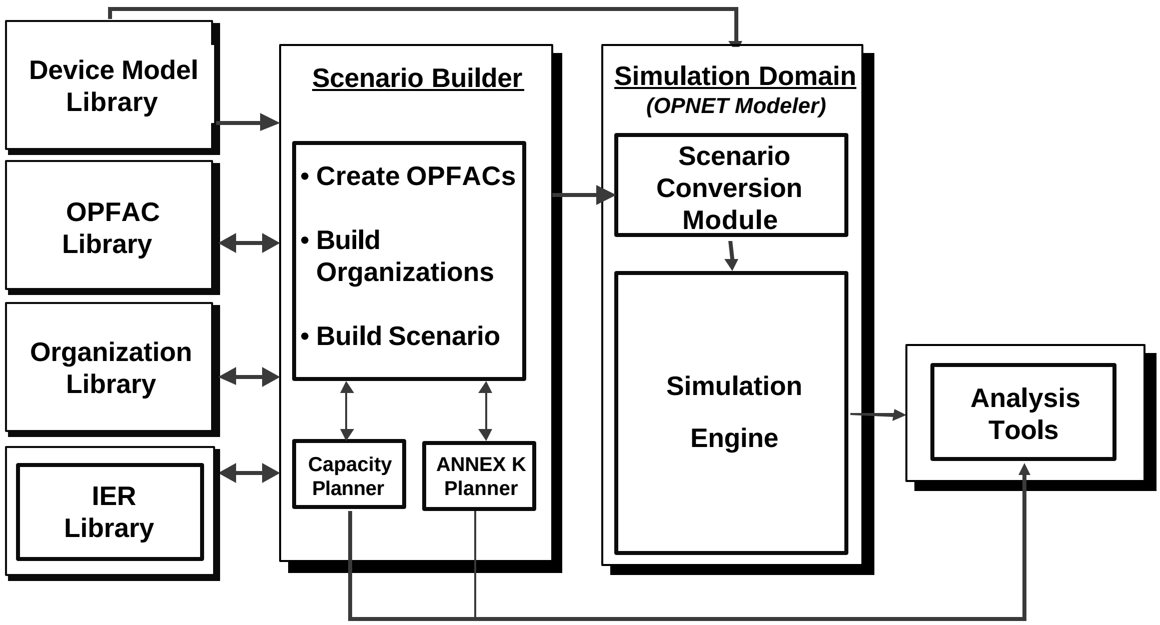


Figure E.7 NETWARS Functional Overview

E.5.1.2 Libraries

Externally provided libraries are essential for the successful formulation and execution of models to answer specific analysis questions. NETWARS Scenario Builder will use these libraries to develop detailed descriptions of operational deployments and scenarios. These consist of Communications Device Models (CDM), Operational Facilities (OPFAC), Organizations, and IER libraries.

- **CDM Library -** The CDM library contains communications equipment representations that are used by both the Scenario Builder and the Simulation Engine. CDMs have the logic and attributes of specific COTS and military communications equipment (routing schemes, number of ports, protocols, and priorities). The NETWARS CDM library consists of OPNET-provided Commercial off-the-Shelf (COTS) device libraries and custom CDMs developed as part of the NETWARS Program. The custom CDMs are either jointly developed or Service-developed, based on the specific needs. DoD components can use the specific interface standards, contained in the *NETWARS Model Development Guide*, to develop custom CDMs to satisfy their unique service requirements.
- **OPFAC Library** - The OPFAC library contains proxy representations of communications equipment, intra-nodal connections, and operational behavior, some of which are capable of movement. Multiple OPFACs can exist within the same vehicle or platform and each OPFAC contains one or more CDMs. Each OPFAC has unique traffic flows within it. Within the selected scenario, OPFACs can be destroyed. They can be created by the Scenario Builder, reused from the library database, or modified from the library database.
- **Organization Library.** - The Organizations library contains groups of OPFACs that are structured/linked by network relationships. Organizations reflect the structure and relationships inherent in current communications doctrine, as it relates to the OPFACs in an organization.

- **IER Library.** - The IER library contains representations of elemental communications requirements between OPFACs. The IERs are based on mission(s) and mission phase(s). Traffic generated from IERs is specific to the mission and can be either externally generated or reused from the library database. The IERs contained in the library can be explicitly invoked according to OPFAC association, or implicitly invoked based on organizational relationships. In addition, specific IERS can be imported from external files (e.g., Microsoft Excel spreadsheets) or defined by the user.

E.5.1.3 Simulation Domain

The Simulation Domain library consists of the Simulation Engine and a Scenario Conversion Module. The Scenario Conversion Module allows the Scenario Builder to provide its output to a COTS Simulation Engine (e.g., OPNET Modeler) in a file structure expected by the Simulation Engine. The Scenario Conversion Module translates organizational representations and information flows into discrete events between sender and receiver pairs tied to specific communications equipment representations in the Simulation Engine.

The Simulation Engine is the **OPNET Modeler** tool, a COTS product by OPNET Technologies. The Simulation Engine takes the scenario representation from the Scenario Builder and environmental factors and then generates and processes events to obtain the needed results. These results are provided to the Analysis Tools for display and interpretation. The performance of the Simulation Engine is critically dependent on the existence of standards-compliant CDM in the Libraries.

APPENDIX F
DATA MINING STRATEGY FOR TOOLSET

F.1 OVERVIEW

The JCOBIAA methodology requires C4ISR architecture data to output an assessment. C4ISR architectures are very complex and have many data elements to consider for an assessment. Because of the complexity of architectures and the diverse locations of the architecture data, a strategy was developed to extract the data from the relevant data sources to populate the tools. As part of the JCOBIAA JT&E, the data mining strategy will be tested in the data population and methodology assessment phases.

F.2 DATA MINING STRATEGY

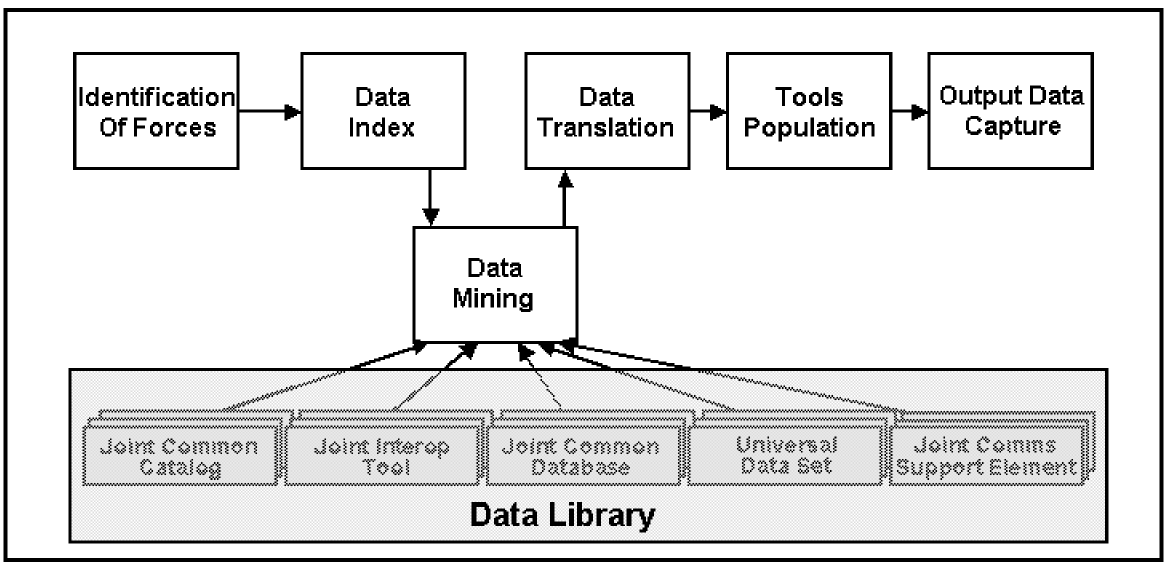


Figure F.1 Data Mining Strategy

Figure F.1 is a flow chart that illustrates the JCOBIAA data mining strategy for extracting data (sources listed in appendix D) for the methodology toolset. It begins with the identification of forces and the required C4ISR systems that make-up the Joint Task Force (JTF). The forces are the baseline for the structure of the JTF and its architecture. The JCOBIAA process will be to access a data index that will point to the required data needed to populate the tools. This process will use a data mining or extraction tool that will access the required database, with permission from the data source, for the required information. If required, the data will then be translated into the correct format for the specific tool to use in its assessment process. Once the tools have the required data, then the methodology is executed with the results validated.

F.3 SUMMARY

With successful execution of the data mining strategy, a legacy product will be provided to the user community that will be beneficial in many applications of the C4ISR architecture development and assessment processes.

APPENDIX G
PROOF OF CONCEPT (FEASIBILITY)

G.1 OVERVIEW

During the JCOBIAA feasibility study, the JCOBIAA team conducted a methodology proof-of-concept (POC) to ensure individual tools would provide the required output for an architecture assessment. The team utilized an existing, reasonable mission and architecture for assessment. The POC proved successful in demonstrating the applicability of tools to assessing JTF architectures.

G.2.0 BACKGROUND

G.2.1 Resources

Resources used to conduct the POC were:

- Various software tools including: static data base tools, dynamic analysis tools and fine-grain analysis tools were considered and tested during the POC.
- Lessons learned archives, including the Joint Universal Lessons Learned System (JULLS), were reviewed and included.
- Universal Joint Task Lists (UJTL's) and other sub-task and service-specific task lists were incorporated in the POC.
- Data exchange requirements and essential elements of information were identified and included.
- Mission threads for high-interest mission areas from Joint Doctrine and the Command Information Superiority Architecture (CISA) were considered and used to develop the mission scenario.
- System testing procedures and results from the Joint Interoperability Test Command (JITC) and Operational Test Agencies (OTAs) were used.
- A notional end-to-end (ETE) test using the Joint Battle Center's Joint C4ISR Integration Facility was researched for feasibility.

G.2.2 Architecture Assumptions

Four assumptions were made regarding C4ISR architectures as the POC was conducted:

- Architectures are designed to support a mission, and with architecture inadequacies, come reduced speed of command, security vulnerabilities, increased resource expenditures, excessive logistics train, and redundant systems. Ultimately, unknown deficiencies in the C4ISR architecture could lead to force losses, conflict escalation, and the potential for mission failure.
- Simplification of the essential information elements provides clarity and efficiency; however, there must be enough detail in the operational and systems views of the architecture for an adequate assessment.

- Static and dynamic analysis tools can assess the validity and efficiency of a C4ISR architecture, and can include outcome measures of effectiveness.
- An architecture assessment is a complex process, and there is no single tool that can answer all the assessment issues.

G.2.3 Data Requirements

The C4ISR architecture data requirements for the methodology assessment are divided into two areas.

- Operational Architecture data includes: mission goals, participants, relationships, mission tasks, Information Exchange Requirements (IERs), and the environment (e.g. terrain, atmospherics, etc.).
- System/Technical Architecture data includes: system parameters, system performance data, system-to-system relationships, system interoperability and performance test results, trouble reports, and network parameters.

This is not a complete list of data requirements, but gives a sample of the types of data that is required to conduct an assessment. The key is that the value of an architecture assessment is linked to the accuracy and currency of the C4ISR architecture data.

G.3.0 PROOF OF CONCEPT

The POC followed the step-by-step JCOBIAA methodology process from the risk assessment through dynamic and fine-grain analysis to ETE testing. Figure G.1 summarizes the JCOBIAA architecture assessment methodology as followed by the POC.

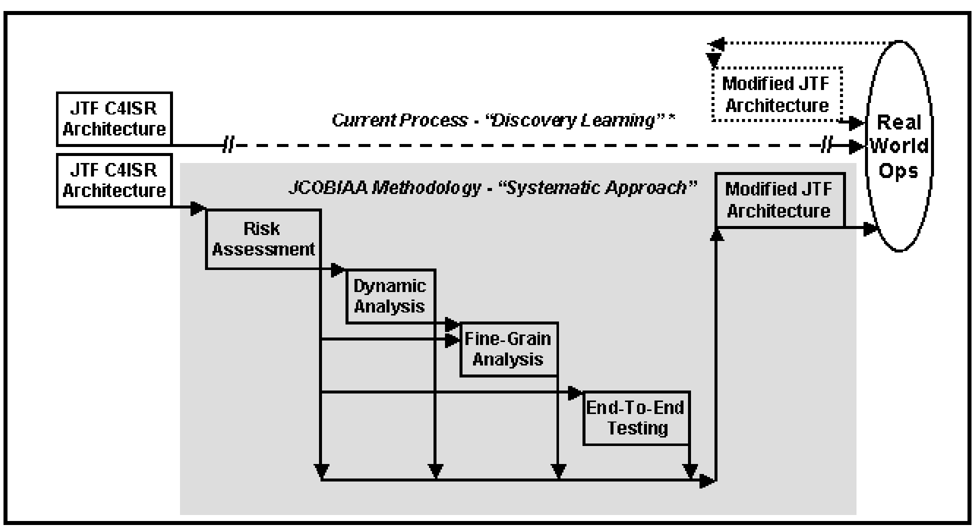


Figure G.1 JCOBIAA Assessment Methodology

G.4.0 MISSION

The mission and architecture selected for the POC was the Combat Search and Rescue (CSAR) mission. The mission scenario was based on a CISA Non-Combatant Evacuation Operation (NEO) scenario. The mission scenario assumptions included:

- An afloat JTF onboard an amphibious assault ship (LHA/LHD) as part of an amphibious Ready Group (ARG) with a Marine Expeditionary Unit (Special Ops Capable) (MEU(SOC)) on standby.
- A JFACC as an Air Force-led shore-based component.
- A Special Operations Force (SOF) CSAR unit provided by an Army Special Operation Center (ARSOC).
- An aircraft carrier on station providing Combat Air Patrol (CAP) support for the CSAR rescue unit.

The CSAR mission operational IER matrix was simplified and sequenced to assist in identifying the mission threads. The developed threads were based on the CISA documentation and Joint CSAR doctrine. Figure G.2 outlines the 14 identified mission threads.

CSAR Functional Threads

OP 6.2.9.2 Provide Combat Search and Rescue

Awareness & Notification

1 Downed aircraft detection and notification
2 Report search and rescue incident
3 Request and task CSAR forces

Situation Assessment

4 Request for intelligence and environmental information
5 Request for additional threat data and collection
6 Process and provide threat and environmental data

Mission Planning

7 Additional information/support to CSAR forces
8 Updated On-scene information and location data

Execution

9 CSAR and RESCORT forces directed to crash site
10 Status of crash site provided
11 Status of aircrew and aircraft recovery provided
12 MEDEVAC and aircraft destruction

Mission Conclusion

13 Termination of SAR mission
14 Wrap-up summary report

Figure G.2 CSAR Functional Threads

The functional threads were displayed in an operational architecture view. Figure G.3 shows an example of an operational view of the CSAR Situation Assessment Thread IV - Request for Intelligence and Environmental Information.

For each functional thread, the operational and systems architecture views were tied together with the required systems and need lines. Figure G.4 shows an example of the integrated view of the CSAR Situation Assessment Thread IV - Request for Intelligence and Environmental Information.

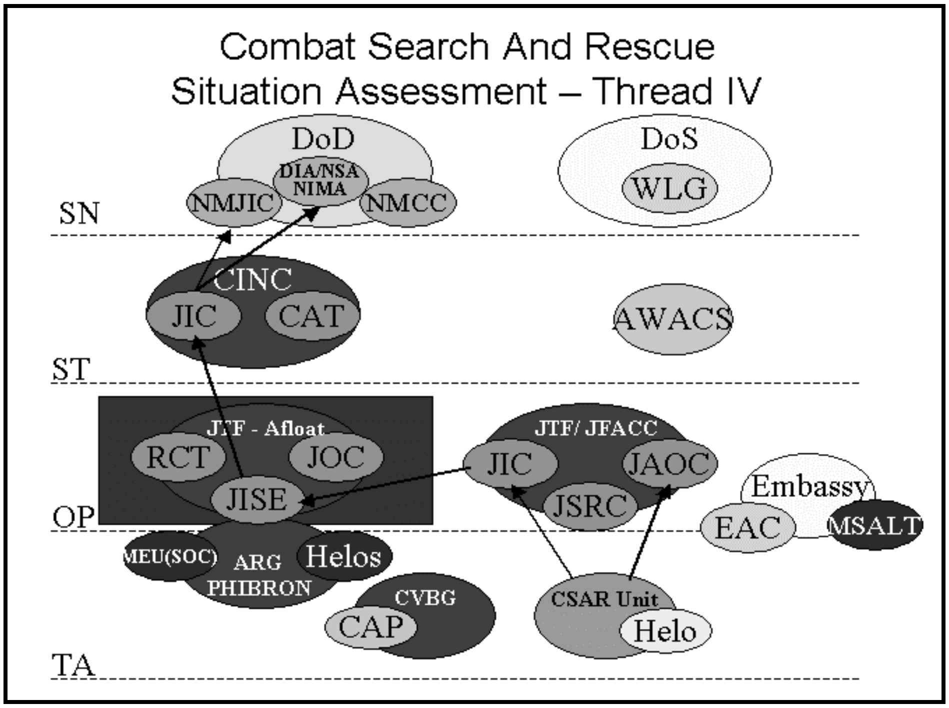


Figure G.3 Operational View Of CSAR Situation Assessment Thread

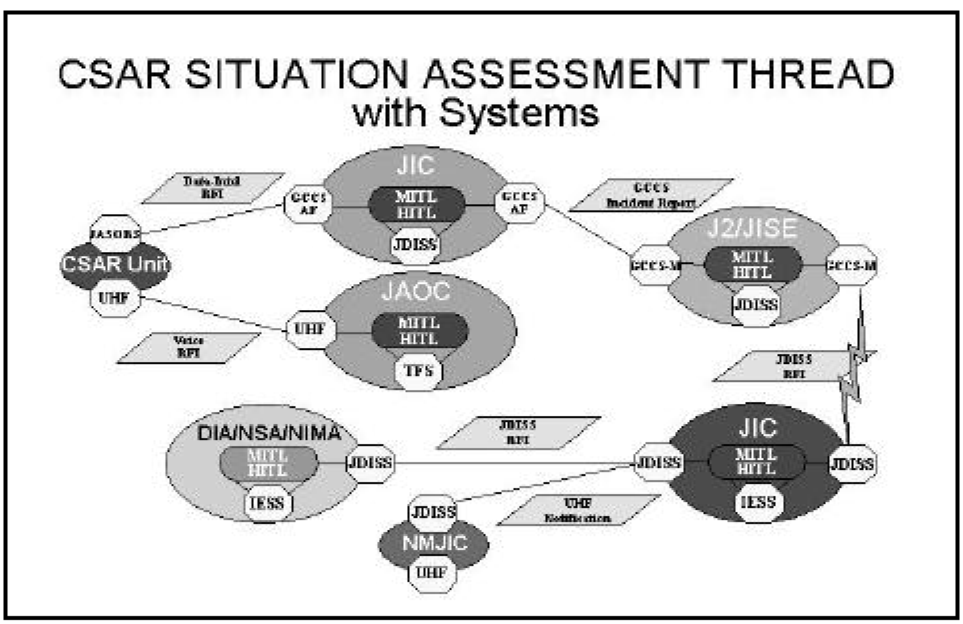


Figure G.4 Integrated View of CSAR Situation Assessment Thread IV

G.5.0 OPERATIONAL ARCHITECTURE RISK ASSESSMENT

The Operational Architecture Risk Assessment looks across the breadth of the operational architecture. As shown in Figure G.5, the risk assessment process compares elements of a given operational architecture to a baseline JTF architecture such as templates of the JTF Representative C4ISR Operational Architecture (JRCOA). JRCOA, developed by USJFCOM, is based on doctrine and validated by Subject Matter Experts (SMEs). The comparison highlights missing and/or unconnected nodes (e.g. Figure G.5 shows the transportation and engineering nodes missing from the JTF-Civil Support architecture). These missing or unconnected nodes are potential risk areas in the architecture. With the use of SMEs and Dynamic Analysis tools, such as Analytica and Extend, the potential risk areas can be analyzed to determine the criticality of the node to the architecture and the mission. The results can then be passed to the Joint Force Commander (JFC) with potential solutions. It also assists in prioritizing subsequent testing. The assessment should be conducted prior to mission execution with recommended solutions provided to the JFC. The tool of choice to conduct an operational assessment is NETVIZ. NETVIZ is a network visualization tool the graphically records physical and logical relationships between network, system and process. It also assembles and analyzes key JTF nodal (e.g. Operational Facility (OPFAC)) relationships.

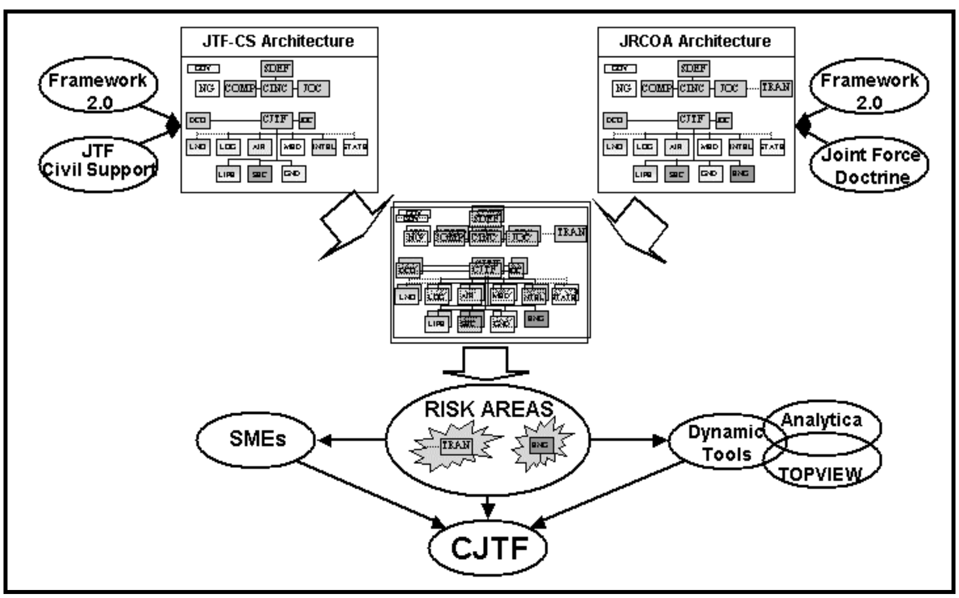


Figure G.5 Operational Architecture Risk Assessment

For the POC, NETVIZ took a notional thread of the USJFCOM JTF Civil Support architecture and compared it to a thread of the JRCOA template. The output listed the unconnected Information Exchange Requirements (IERs) in the JTF Civil Support architecture and produced a plot of connected to unconnected nodes, shown in Figure G.6. NETVIZ demonstrated the capability to conduct a comparison of nodes and the ability to analyze the unconnected nodes for risk areas in the architecture.

Output from the Operational Architecture Risk Assessment consists of nodal comparisons; mission-based information requirements, including information threads and critical connections; and verification of appropriate nodes and information flows.

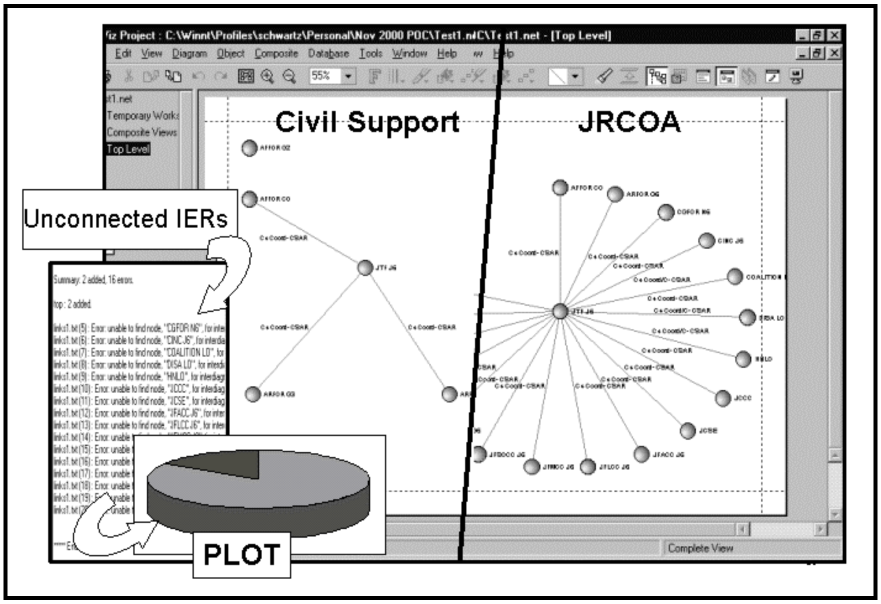


Figure G.6 Operational Architecture Comparison

G.6.0 SYSTEM AND INTEGRATED ARCHITECTURE RISK ASSESSMENT

The System and Integrated Architecture Risk Assessment looks across the breadth of the integrated architecture. It pinpoints high-risk components of complex, integrated architectures. It also assists in prioritizing subsequent testing. The tool of choice is the Joint Tool for Interoperability Risk Assessment (JTIRA). JTIRA is a SPAWAR SSC Charleston developed tool that identifies the high-risk areas using functional threads drawn from essential force capabilities. It also organizes, tracks and summarizes system data and test results into an interpretable risk value.

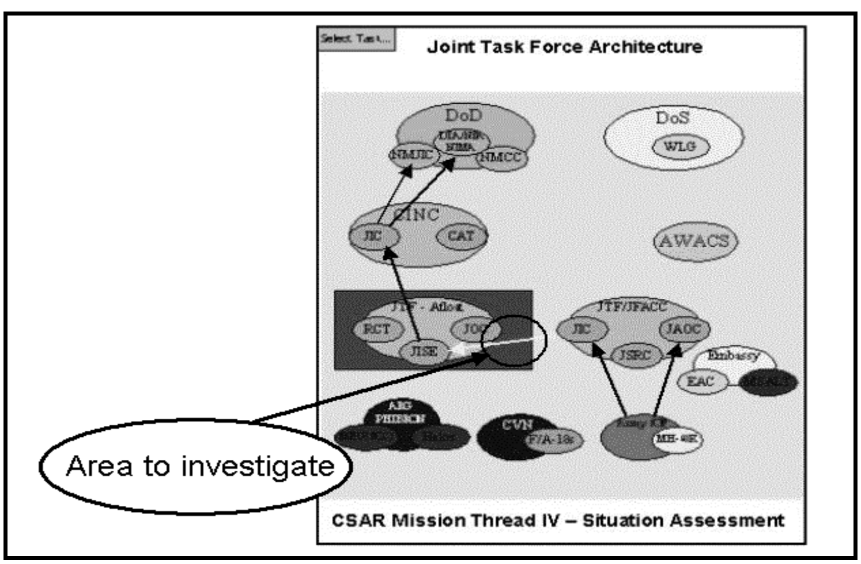


Figure G.7 Integrated View Of CSAR Mission Thread

For the POC, JTIRA used the CSAR scenario and assessed the intelligence and environmental request for information (RFI) mission thread. Figure G.7 shows the integrated architecture view of CSAR Mission Thread IV. JTIRA highlights a thread connection from the JFACC Joint Intelligence Center (JIC) to the JTF Joint Intelligence Support Element (JISE) node that is an area to investigate. After highlighting the connection, JTIRA displays the equipment string from the two nodes, shown in Figure G.8. The string highlights the GCCS-Afloat as a system requiring further analysis. Further analysis is necessary to determine risk and the deficiency to the architecture.

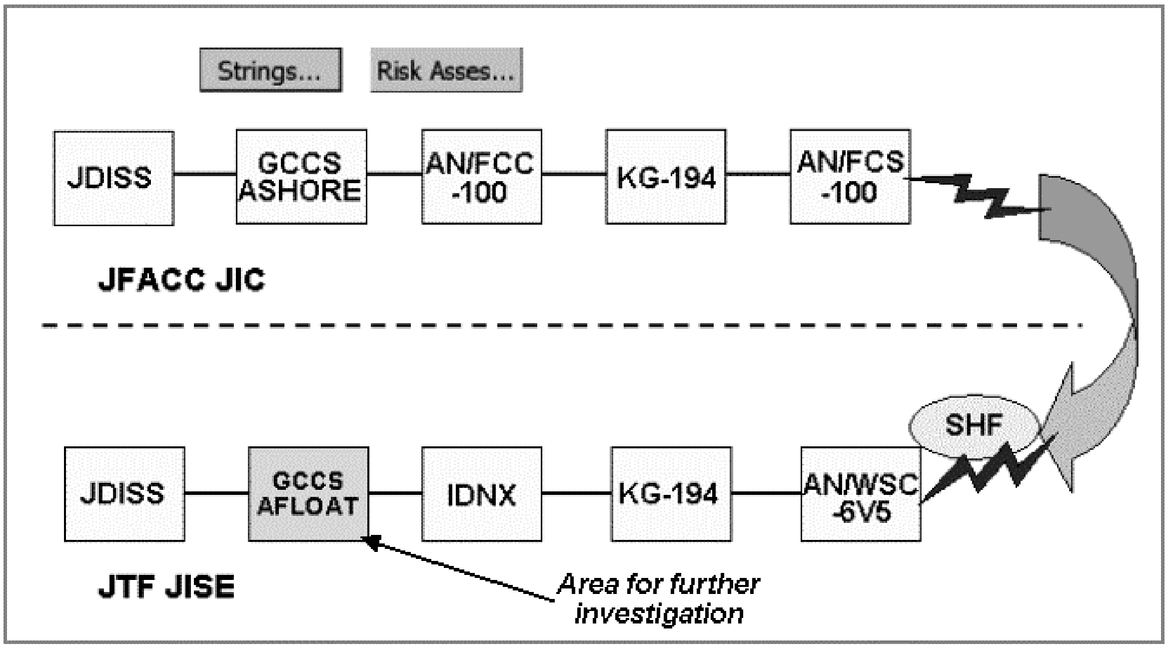


Figure G.8 CSAR Equipment String Analysis

Output from the System and Integration Architecture Risk Assessment consists of the probability of system deficiencies; system risk associated to mission; prioritized system test requirements; and end-to-end test combinations.

G.7.0 DYNAMIC ANALYSIS

Dynamic Analysis assesses the contributions of C4ISR systems and architectures to mission effectiveness. It also provides assessment of dynamic C4ISR parameters and their interactions. The tool of choice is TopView. TopView is an Extend software-based Network-Centric Warfare performance analysis tool. The second tool of choice is the Dynamic C4ISR Analytic Performance Evaluation (CAPE). CAPE, based on both Extend and Analytica software tools, evaluates C4ISR architectures and alternatives.

For the POC, TopView modeled CSAR Thread IV, the intelligence and environmental RFI thread. Figure G.9 is a snapshot of the Extend software engine of TopView with the system nodal connections. After execution of the run, a sample data output displayed the time of response for the intelligence RFI, shown in Figure G.10. This output is only one of several possible outputs.

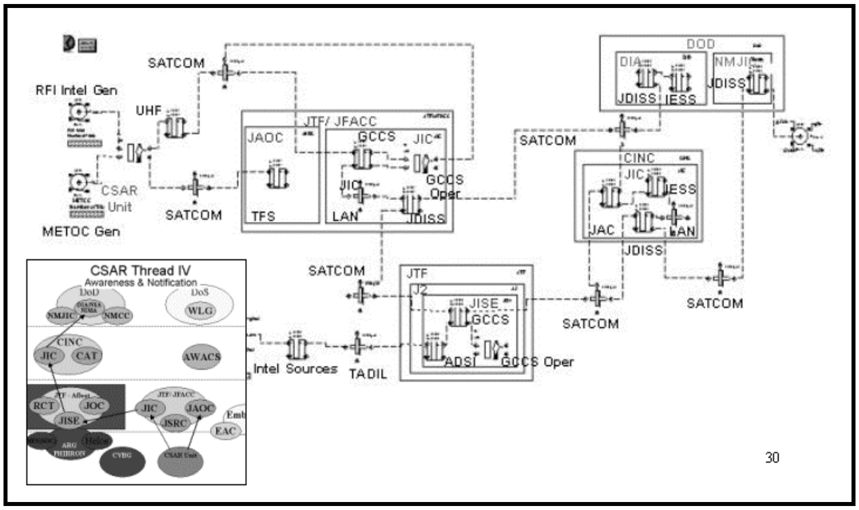


Figure G.9 TopView (Extend) Execution

Output from the Dynamic Analysis consists of relationships between systems; information flow, including time to accomplish, backlogs and event sequencing; scenario comparison; resource utilization; and metric comparisons.

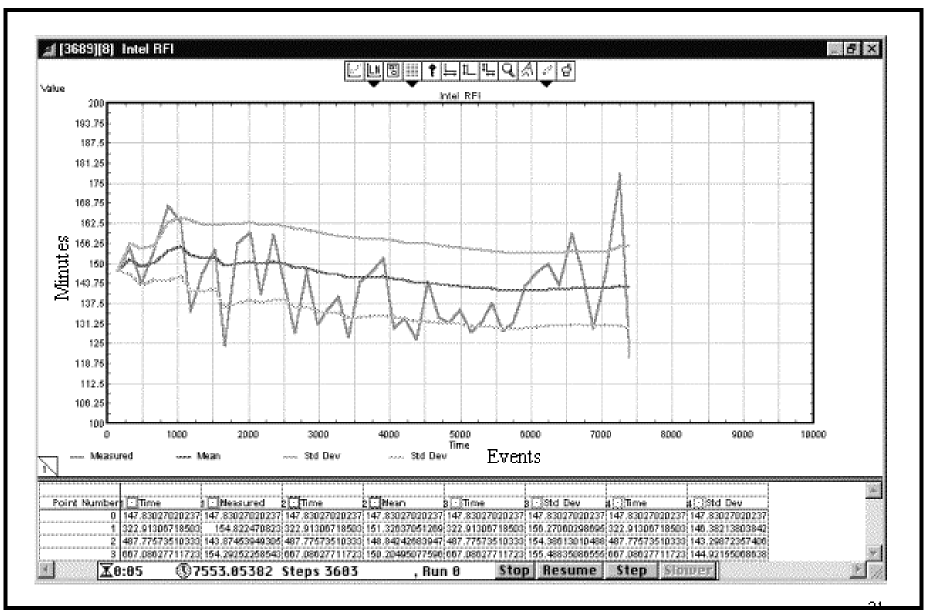


Figure G.10 Simulation Run Data Output

G.8.0 FINE-GRAIN ANALYSIS

Fine-Grain Analysis is a detailed functional/mission thread analysis process. It analyzes interrelationships between the operational view and system view of integrated architectures. It identifies behavioral and performance characteristics/shortfalls of C4ISR architectures. Finally, it focuses assessment on problem areas. Tools include TopView and the Network Warfare Simulation (NETWARS) tool. NETWARS measures and assesses the information flow through military communications networks.

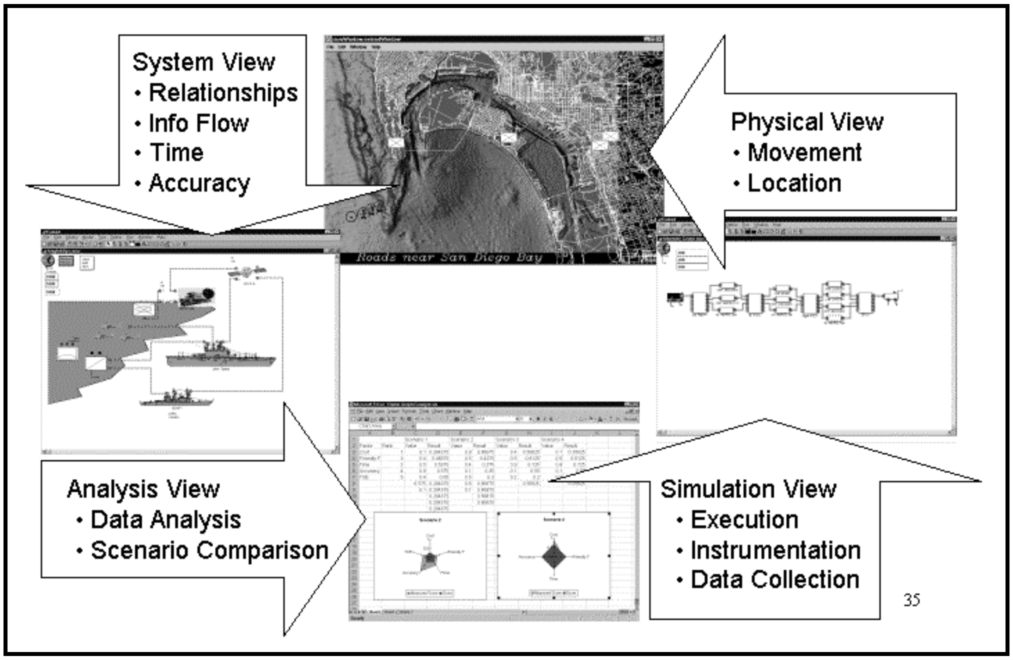


Figure G.11 TopView Analysis View

Output from Fine-Grain Analysis consists of detailed relationships between systems; critical information flow analysis; detailed comparisons of mission threads; resource utilization analysis and data collection schemes. Figure G.11 are screen captures of several analysis views in TopView that display physical movements, system relationships, data analysis and mission thread comparisons.

G.9.0 END-TO-END TESTING

End-To-End Testing connects and tests systems in an operational configuration. The methodology examines and evaluates C4ISR systems and architecture to confirm deficiencies and identify solutions. An example test facility is the Joint Battle Center's Joint C4ISR Integration Facility (JCIF). The JCIF configures JTF C4ISR architectures one-level deep; maintains current and legacy software versions; can conduct tests at both the GENSER and SCI-levels of classification; and is Repeat stimulator capable.

The POC investigated the ability of the JCIF to configure mission threads. Specifically, Mission Thread IV, which was highlighted as an area to investigate, was viewed in greater detail for configuration in a test. Although the laboratory did not actually set up and test the thread, the capability to configure the lab and perform the test was confirmed. Figure G.12 is the GCCS-M (Afloat) test configuration needed to test the area to investigate in the CSAR Mission Thread IV.

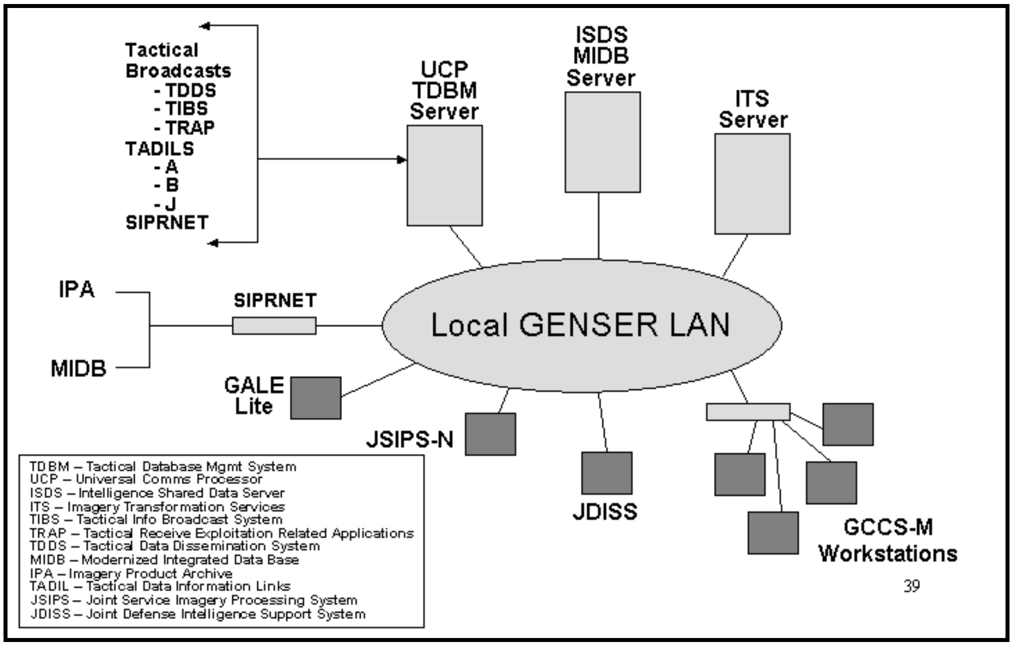


Figure G.12 CSAR Thread IV End-To-End Test

Output from End-to-End Testing includes: reducing uncertainty in tested configurations; identifications of deficiencies; identification of potential solutions; and validation of recommended solutions.

G.10 SUMMARY

The POC was a successful performance of the prototype of the methodology. Specifically, the POC demonstrated that:

- C4ISR Architectures do exists and are available
- Required data sources to drive the assessment tools are identified
- Data is accessible to drive the tools of the methodology for the test
- The assessment tools selected performed as expected
- The JCOBIAA methodology provided the expected output of data

The methodology has challenges in data accessibility, cost and ability to train to the tools, however, the POC demonstrated that the challenges would be overcome to achieve a rapid, relevant assessment to the warfighter.